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WATER RESOURCES STUDY

Metropolitan Spokane Region

APPENDIX H - VOLUME 1

Plan Formulation and Evaluation

JANUARY 1976

METROPOLITAN SPOKANE REGION
MSR WRS
WATER RESOURCES STUDY

LIST OF REPORTS AND APPENDICES

REPORTS

Summary Report

Technical Report

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METROPOLITAN SPOKANE REGION WATER RESOURCES STUDY

APPENDIX H (VOLUME 1)

PLAN FORMULATION AND EVALUATION

11 JANUARY 1976

12 466p.

Department of the Army
Corps of Engineers, Seattle District

Kennedy-Tudor Consulting Engineers

KENNEDY TUDOR

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The summary report was prepared by the Seattle District Corps of Engineers. The technical report and appendices were prepared for the Seattle District, Corps of Engineers by Kennedy-Tudor Consulting Engineers.

PREFACE

With the enactment of the Federal Water Pollution Control Act Amendment of 1972 (Public Law 92-500), new national goals have been established for the elimination of pollution discharges into our streams and lakes. This appendix is a part of the report prepared to assist local government in satisfying State and Federal Requirements relating to Public Law 92-500. The suggestions contained in this report are for implementation by local interests with available assistance from other local, State and Federal agencies. The study suggests a regional wastewater management plan for the metropolitan Spokane urban area and provides major input to Washington State Department of Ecology Section 303e plans for the Spokane River Basin in Washington State. Also included in the study are planning suggestions for urban runoff and flood control, and the protection of the area's water supply resources.

As listed on the inside front cover, documentation for this study consists of a Summary Report and a Technical Report with supporting Appendices A through J.

The Technical Report summarizes Appendices A through J, which contain 58 individual task section reports prepared during the study. These task sections are listed by title in Attachment I of the Technical Report. Generally, the numbering of appendix task sections reflects the following system:

Study Task Sections	Type of Study Activity
300's	Data Collection
400's	Data Evaluation and Projection
500's	Identification of Unmet Needs
600's	Development of Alternative Plans
700's	Evaluation Comparison and Selection of Plans
800's	Institutional Arrangements

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Task section identifier — Identifies page number, numbered consecutively from beginning of task section

APPENDIX H (VOLUME 1) - PLAN FORMULATION AND EVALUATION

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SECTION 500

UNMET NEEDS

WATER RESOURCES STUDY

METROPOLITAN SPOKANE REGION

SECTION 500

UNMET NEEDS

10 October 1975

Department of the Army, Seattle District
Corps of Engineers
Kennedy-Tudor Consulting Engineers

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SECTION 500

UNMET NEEDS

Objectives

The purpose of this section of task reports is to define and describe detailed water resources management needs in the basic categories of:

1. Water Pollution Control Needs
2. Flood Control Needs
3. Water Supply and Distribution Needs
4. Urban Runoff Needs

A clear and concise understanding of these needs is the basis for the development, evaluation and selection of plan alternatives. No plan alternative should be seriously considered which does not substantially satisfy these needs and provide the means to solving the water resources related problems of the Metropolitan Spokane planning area. Total or absolute resolution of these needs may not be technically or financially reasonable, but it is important that absolute goals in the resolution of these needs be identified in order to encourage improvements which at least move in the direction of realizing these goals, if not fully satisfying them. This leads to the necessity of establishing priority relationships between needs.

The interrelationship of needs categories is an important consideration in itself. Needs satisfaction in one category may impart a need in another category either beneficially or detrimentally. For example:

The improvement of storm drainage collection and disposal may resolve a localized flooding and drainage need, but may negatively impact other need categories such as flooding and water quality at some other location. This consideration is also the fundamental essence of water resources management by watershed basins with emphasis on the total needs of the area, not just immediate solutions to localized problems.

Similarly the projection of needs is important to ensure that current decisions with regard to implementing programs to satisfy these needs are also compatible with future requirements. This suggests the need to retain flexibility in water resources management planning as well as expandability. The optimum resolution of today's need may not be consistent with the best solution of the same need relative to future conditions.

In addition to the categorization of needs by function, needs may also be described in terms of broader performance classification:

1. Regulatory compliance, although it pertains primarily to water quality needs, is a fundamental consideration applicable to the assessment of all plans, inasmuch as compliance is prescribed by law. Regulatory compliance needs form the backbone of all wastewater plans and apply to various aspects of flood control, urban runoff, and water supply plan requirements.
2. Physical facilities to accommodate community growth constitutes a need which is directly dependent on pressure

created by economic and population growth. Planning decisions related to growth needs deal primarily with determination of policies which anticipate these needs or policies which react to them. There has been considerable discussion in recent years also concerning the use of physical facilities development as a tool to enforce land use policy objectives. This procedure is regarded by many as enforcement of planning policies which have failed at the regulatory level because of special political influence on land use policy regulation. This is in opposition to the point of view that land use should be regulated legislatively and that facilities planning should be responsive to land use, and not used to control land use.

3. Environmental improvement is an additional broad category of need which is nominally the basis of regulations and thereby would be satisfied by meeting regulatory standards. However, it must be recognized that regulations are generalized, and in a sense define minimum standards. Regulations concerning flood control, water supply, and urban runoff do not necessarily include environmental requirements.

Water Pollution Control Needs

General Water Pollution Control Needs. The basic water pollution control need is the requirement to comply with various state and

federal laws and regulations. This need is common to the total study area, as it is with the rest of the nation. Federal regulations are basically described in Public Law 92-500 as interpreted by the administrative guidelines thereto. State regulations primarily supplement the federal regulations and provide that the state may set more restrictive standards in special water quality determinative locations. These standards and regulations are discussed in detail in Task Report Section 317.

The other major water pollution control need is to provide community sewerage facilities within the large urban population areas of Metropolitan Spokane which include the unsewered areas of the City of Spokane, North Spokane and Spokane Valley.

A need related to that above which involves the general metropolitan area is to provide a positive means of protection of the unique water quality of the primary Spokane aquifer, which currently is the receiving water for wastes generated by approximately 80,000 persons.

There is the recognized need to improve the water quality at the Spokane River which exerts the most noticeable impact on Long Lake. There is a need to control the overflow bypass of untreated wastes to the Spokane River during heavy storm runoff.

Water pollution control needs can also be summarized generally by land use categories as follows:

Urban Residential. The most critical water pollution need in urban residential areas within the City of Spokane relates to the need to eliminate the flooding of basements and public streets by sewage, caused by sewer backups as a result of surcharging of combined sewers

during periods of heavy storm runoff.

There is a need for public systems of wastewater collection in urban areas where sewer systems do not exist.

Suburban Residential. The most critical suburban area need is to make a policy decision on where and whether to construct sewers for the collection and treatment of wastewater or to continue the practice of discharge of wastes individually to the ground above the groundwater aquifer.

Commercial. Commercial areas are subjected to the hazards of combined sewer overflow or backup noted above and additionally experience a need for collection systems which is critical for heavy waste producing commercial activities such as restaurants and laundries where septic tank systems typically are inadequate to handle high volumes of flow and strong wastes with high grease content.

Industrial. Existing industries served by sewerage systems have a need to participate in upgrading of facilities to meet discharge standards. Industries with independent waste treatment and discharges to surface water face the need to meet discharge requirements in order to maintain valid discharge permits. Industries discharging in a manner which impacts groundwater need to be monitored closely and controlled to minimize impact on groundwater quality.

Agricultural. Water pollution control needs relating to agricultural land use within the study area include a need to minimize the impact of point sources such as livestock feedlots and poultry raising; to minimize the direct leaching of nutrients and other salts as a result

of excessive applications of cheap irrigation water; and to improve farming practices in the wind-blown Palouse soils areas in order to minimize soil erosion and wash-off to surface waters.

Detailed Water Pollution Control Needs

The following detailed comments concerning the water pollution control needs of the study area are organized in terms of specific geographical locations. This needs summary is presented with the intent of describing representative needs conditions applicable to a given location within the study area and does not attempt to tabulate or describe each instance where a similar condition or need exists. Existing conditions will be described as well as an estimate of projected conditions relating to the same condition in the event no action is taken to modify the existing conditions.

Urban Areas, City of Spokane

Sewerage System Needs. Like most large cities, the City of Spokane sewerage system has grown with the City to a size and complexity which was never contemplated at the time of its origin. The initial growth of the City in the early 1870's was near the river in the vicinity of the falls which afforded convenient water supply from upstream and convenient disposal downstream. The sewerage needs of the City of Spokane are best understood by a knowledge of the system and its operation. The following narrative prepared by Mr. Jim Day, a former sewer system maintenance superintendent, provides an excellent summary of these

needs:

The Spokane sewer system grew with the City. It is about 95% combined. That is, it is designed to carry both sanitary wastes and storm runoff in a common conduit. These sewers were constructed to empty into the Spokane River. As the City and the sewer system grew, the system was served by some 35 such outfalls in the river. Needless to say the water quality of the river was not good. In the early 1900's when two districts, Browne's Add. and the lower part of Cannon Hill, were sewered, separate sewers were built. Until the early 1960's that was the full extent of Spokane's separate sewers. It was then decided that any newly developed or newly sewered area should have separate sewers. Since that time in a few old districts, where the storm overload problem was extremely severe, sewers have also been separated. As of January 1, 1974 the Spokane sewer system consisted of a total of 660.32 miles of sewer.

After years of discussion a bond issue was passed in 1946 and with the assistance of state and federal funds a sewage treatment plant and system of intercepting sewers was started. The intercepting sewer generally follows the course of the river to the Treatment Plant, which is on Aubrey White Parkway near where the river leaves the west limits of the City. In June, 1958 the first sewage was turned into the interceptor and

the plant was put into service. At that time some 75% of the sewers were intercepted carrying perhaps 60% of the sewage of the City. By 1962 the interceptor was completed and all the sewers diverted to the plant. The only exception was a very small area near Trent and Hamilton which was finally diverted to the interceptor in 1971.

As the interceptor follows the course of the river each of the old outfalls was intercepted. There are variously designed interception devices, mostly leaping weirs, at these points of interception. These weirs were supposedly set to take 2 to 3 times normal dry weather flow. Wherever the load in the interceptor has permitted, the setting has been opened to permit a larger flow to the Treatment Plant, thus reducing wherever possible storm overflows to the river. The discharge of these storm bypasses to the river is a most undesirable condition which occurs, perhaps, as many as one hundred times per year. These overflows vary from a mere slop over at a few weirs to millions of gallons through every bypass in the City.

The climate and rainfall of any city has a great effect on the function of its sewer system. Spokane is certainly no exception. Spokane has basically a dry climate with cold winters and hot summers. Rainfall only averages 15 to 17 inches per year. Like many dry climates Spokane is subject to terrific rain storms of great intensity hitting comparatively small

areas of the City. These cloudbursts seem to occur May through September. Most are carried on southwesterly winds and appear to have a front of extremely heavy rainfall about a mile wide. These storms seldom hit the weather station for an accurate rainfall measurement. One such storm was measured in a private rain gauge as 2.2 inches in ten minutes. Storms of that intensity or more likely half that intensity pass through the City on an average of twice per year. Years when no such storms occur are not uncommon but also years when four or even six or seven such storms occur are not uncommon, either. All day steady rains, of about one or two inches in twenty four-hours, cause no sewer problems of consequence. Neither do snow melts in the late winter or spring; perhaps a little surface flooding when water cannot readily reach the catch basins. Four times in the last forty years several hundred frozen catch basin connections, after a winter of the most extreme cold, have created a few problems but none truly serious. Spokane's generally dry, hot summers tend to promote tree root growth into the sewers. It has been often noted that in the year following an exceptionally dry summer the root problem greatly increases.

The storm overload problem and resultant backups into basements is by far the most difficult of all City sewer operation problems. When a City sewer is blocked and backs into someone's basement, the City crews clean it. Usually it is only one, at most a half dozen basements. When a flash storm hits an area

of the City and anywhere from 50 to several hundred basements get backups, cleanups by the City are impossible. These storm backups might be any amount from a little puddle around a floor drain to several inches, in extreme cases several feet, of muddy storm water mixed with domestic sewage. When the storm recedes it leaves a residue of mud and worse on the floor. It is quite understandable that people in whose home this has occurred might feel that there are more serious cases of pollution than found in the river. Everytime this backup occurs in a neighborhood some people attempt to avoid reoccurrences in the future with check valves. Some plug the floor drain. Others, perhaps most, just hope it will not reoccur but sooner or later it does. It has been noted that as more people in the lowest houses on a sewer install check valves the level at which storm backups occur rises to the higher basements. In more recent years, since about 1966, the plumbing code has required installation of check valves (back water valves) in any new construction with plumbing fixtures below street level. This a most desirable step. Check valves, however, are not an absolute guarantee to avoid sewer backups. They must be cleaned and serviced periodically. Many home owners fail to do this. Because of this all too common storm overload problem the Sewer Div. makes every effort to ensure that all sewers are maintained to full designed capacity.

Spokane has very close to 13,000 catch basins or other storm

water catching devices. About 300 of these are seepage catch basins. That name explains their means of functioning. They are nearly all in unsewered districts. There are about 1000 gutter inlets, mostly connected to a catch basin well out in the roadway where a street widening has set the curb line back. The balance of the catch basins are probably standard to most cities. They consist of a grate in the gutter to catch storm water, a sump three to four feet deep below the outlet and an outlet, normally 8" to the sewer. These catch basins are trapped with a galvanized iron 90° bend where the outlet pipe leaves the basin. This prevents escape of odors from the sewer and to a degree stops the discharge of mud, sand and floating objects into the sewer. In several districts in Spokane where storm backups were especially frequent and severe, the Sewer Division has removed the 8" trap, inserted and cemented about three feet of 4" pipe into the 8" and replaced the 8" trap with a 4" trap (bend). This holds some of the storm water in the street for a slightly longer interval. It has proven to be of some benefit during overload situations, and no interference during normal rainfall.

Catch basins must be cleaned periodically. This cleaning must be performed several times per year in a very few cases at the foot of hills to once a year which is desirable. In most cases the past cleanings, with exceptions, has averaged about every year and a half. Even at best a certain amount of sand, silt

and gravel escapes to the sewer. Although on occasion an accident occurs that completely blocks a sewer with this material.

Specific Areas of Spokane with Severe Problems

The following section will describe nine specific areas in Spokane which experience severe sewer problems. Refer to Figure A-1 for the locations of these nine areas.

Section A. This zone in the extreme Northwest corner of the City experiences perhaps the worst storm water overloading of any other area, except for zone E. However, in the numbers of people affected, zone A ranks first. The plumbing code requires that homes built after 1965 must have backflow prevention devices (check valves). Unfortunately, most of the homes in this zone were built prior to 1965, and consequently, are affected quite severely by stormwater overflows and subsequent basement floodings.

As more and more people install check valves in their basements, it has been observed that basements at higher elevations begin to flood. The main trunk in Assembly St. is especially prone to surcharge. The tree root problem in this zone as well as the maintenance are considered to be normal.

Section B. The Cannon Bowl area has perhaps the worst tree root problem of any area in Spokane's sewer system. Here, the sewers are poorly constructed. Fortunately, this area has no combined sewers and consequently, storm overloads are not found here. However, due to

the extreme tree root problem, maintenance is very high; usually three times per year. Other areas with combined sewers in this section do experience frequent storm overloads. This is particularly evident in the sewers under Wabash Street. Here, the laterals are surcharged before they reach the trunks.

Section C. Frequent storm overloads and backups occur on the four trunk lines feeding the main Perry Street Sewer. Fortunately the sewers here are deep and most basements have checkvalves. The Central Avenue area is especially hard hit by these storm backups. There are also frequent and severe stormwater backups along Addison and Division Streets. The tree root problem here is increasing and more than normal maintenance is required.

Section D. This area is subject to frequent and severe stormwater overloads, but fortunately, the sewers here are deep and there are few basements. Backup problems aren't quite as evident here. The tree root problem is increasing and more than normal maintenance is required.

Section E. This area, especially near Stevens & Indiana Streets, is the most severely storm water overloaded area in Spokane. Although most basements have backflow prevention devices, occasionally the street catch basins back up which results in street flooding and flooding of street level store fronts. The flooding of streets with storm water mixed with sanitary sewage is an extremely dangerous public health problem. In this section there are no serious tree root problems or associated maintenance requirements.

Section F. Sewers in this section are in poor repair. Noticeable exfiltration causes a decrease in sewer velocities and results in

heavy materials settling out. Consequently, sewers backup quite easily. Sewers here are surcharged in any storm event even slightly above normal. Fortunately there are few basements in this area. Tree roots are quite bad in this area and twice annual maintenance is required.

Section G. This section includes the Central Business District and also Spokane's oldest sewers. Some of the sewers now in use were constructed in the 1890's. The sewers here are generally in bad shape with much evidence of pipe failure. This area is also faced with heavy storm overloads, which has caused much of the pipe damage. Basement flooding is prevalent here. Tree roots are less than normal here, but the southern end of this section has quite severe tree root problems. High maintenance is required in this section. This is one of the few areas in Spokane that has had evidence of rats living in the sewers.

Section H. These sewers are heavily storm overloaded, and there have been many instances of basement flooding. Tree root problems are bad here and more than normal maintenance is required.

Section I. As in section H, tree roots are bad and there are frequent storm water overloads. Maintenance here is more than normal. There are large amounts of infiltration here due to the draining of nearby swamps.

The above described sewerage system needs of the City of Spokane are described primarily as existing needs. Projected needs for sewerage system improvements are similar with only nominal increases in severity of problems anticipated in most areas. The critical areas of need for correction of combined sewer overflow are substantially

developed at near-saturation density and it is not anticipated that this need will extend to recently annexed City areas or areas which may annex in the future, inasmuch as the City has adopted a policy of sewer separation for new development. In all other respects projected sewerage system needs are expected to be similar to existing needs except that improved sewer pipe jointing technology should minimize root damage and infiltration/exfiltration problems.

Approximately 70% of the area served by the City of Spokane sewerage system utilizes a combined wastewater/storm drainage system. These areas occur essentially in the central area of the city, with separate sanitary sewers available in newer developments in the northwest, southwest, and southeast corners of the City and in a narrow band along the river. The combined sewers have inadequate capacity to convey both storm drainage and wastewater. The impact of combined waste and storm sewers is that the system proves inadequate to properly handle either function. Sewers of adequate size to handle storm water are too large to provide efficient wastewater conveyance. Sewers properly sized for wastewater are too small to meet the needs of peak storm runoff flows. The result is a hazardous combination of flooded basements, popped manhole covers, pipeline failures, and the discharge of untreated raw sewage into streets and as direct bypass flow to the river. Flow backups from overloaded combined sewers cause extensive flooding of basements with untreated sewage. This problem cannot be looked at as a mere inconvenience to the homeowner. It is a serious public health hazard as well as a continuing source of major liability to the City of

Spokane. It is also a major drain on the maintenance and manpower resources of the City to provide cleanup services. One of the most severe problems with combined sewer backups and overflows occurs in the Assembly Street area. This is one of the most extensive backup problem areas of the City, although other areas have also been affected.

Flow backups from overloaded combined sewers cause street flooding with untreated sewage and storm drainage. The older section of the City north of the river, in the vicinity of Division Street, is critically affected by this problem. An area of about a six block radius from the intersection of Stevens Street and Indiana Avenue is about the most severely affected area of the City for sewer backup problems. Along Division Street between Buckeye and Indiana Avenues it is not unusual for catch basins to overflow and flood the street to the extent that street level stores are flooded. In an effort to minimize basement flooding and the other consequences of inadequate combined sewer capacity, catch basin inlets in many areas of the City have been throttled to reduce storm inflow. The result is that streets act as conduits for storm runoff during periods of high intensity rainfall. In other areas overloaded sewers may force open manhole covers and discharge raw sewage into the streets. The results are hazardous to traffic and not conducive to good public health.

Excessive combined sewer flows have caused serious pipe failures and extensive damage to streets and property. One example of this occurred in 1957 when a severe storm hit the downtown area. The trunk sewer leading over the hill in the vicinity of Cedar Street and Riverside

Avenue was completely washed out causing damage to the apartments on the hillside and to homes below the hill. Failures of overloaded pipelines have caused extensive property damage on several occasions and have threatened much greater damage. There are many areas of the City which are vulnerable to this condition, where a combination of undersized and overaged pipeline subjected to an unusually intense storm runoff could cause severe property damage.

Many collection sewers in Spokane are old and are subject to excessive maintenance needs. Many trunk and interceptor sewers in Spokane were constructed in the 19th century and are approaching the end of their practical economic life. In many areas of the city, water seeking plant roots find access into collection sewer pipes through cracks and joints which were constructed at a time when modern gasketed joints were not available and when concerns with infiltration flows did not exist. These lines pass through the central business district in some areas and would be very costly to replace or repair to meet modern standards. The complication of combined sewage flows discussed under item 5 result in this condition being one of the more critical wastewater management problems facing the City of Spokane at this time. The Cannon Bowl area, although it is a separated sanitary sewer system, is one of the worst problem areas in the City with respect to tree roots and sewer maintenance needs. Most sewers in this area are located in back lot line easements in sandy soil. To quickly convert a naturally barren area, residents planted large numbers of poplars, willows, elms, and other fast growing trees which develop long

root systems seeking water. Cracked sewers are one source of water for these roots. Sewers in this area must be rodded at least three times per year to cut roots and prevent breakage.

Sewage Overflow Bypass Elimination Need. Relief bypass of excess combined sewers directly to the Spokane River at 44 locations and of excess combined sewage flows at the Spokane central sewage treatment plant result in the discharge of untreated sewage into the river. The impact of this condition is to permit the discharge of untreated wastewater to the river, which is a significant pollutant load. The present practice of bypassing a major portion of plant inflow during the first flushing storm of the season and during high inflow conditions is a significant contribution to BOD and nutrient loading of the Spokane River. This practice negates the benefits of treatment capability during periods of high storm runoff. Continuance of these practices will to a degree negate the improvements being planned to improve the Central Treatment Plant effluent quality.

Sewage Treatment Improvement Needs. The existing City of Spokane central sewage treatment plant effluent quality is in violation of present discharge and receiving water standards. There is a present need to upgrade the level of treatment at this plant from primary to a minimum of secondary treatment. The State Department of Ecology and the Environmental Protection Agency have ruled that there is a need to provide advanced treatment in the form of phosphate removal. The Spokane central sewage treatment plant has been identified as the major source of BOD and nutrient loading to the Spokane River and has been

during periods of heavy storm runoff.

There is a need for public systems of wastewater collection in urban areas where sewer systems do not exist.

Suburban Residential. The most critical suburban area need is to make a policy decision on where and whether to construct sewers for the collection and treatment of wastewater or to continue the practice of discharge of wastes individually to the ground above the groundwater aquifer.

Commercial. Commercial areas are subjected to the hazards of combined sewer overflow or backup noted above and additionally experience a need for collection systems which is critical for heavy waste producing commercial activities such as restaurants and laundries where septic tank systems typically are inadequate to handle high volumes of flow and strong wastes with high grease content.

Industrial. Existing industries served by sewerage systems have a need to participate in upgrading of facilities to meet discharge standards. Industries with independent waste treatment and discharges to surface water face the need to meet discharge requirements in order to maintain valid discharge permits. Industries discharging in a manner which impacts groundwater need to be monitored closely and controlled to minimize impact on groundwater quality.

Agricultural. Water pollution control needs relating to agricultural land use within the study area include a need to minimize the impact of point sources such as livestock feedlots and poultry raising; to minimize the direct leaching of nutrients and other salts as a result

temperature of the river and impoundments inasmuch as temperature is the primary factor influencing biological growth and related visible water quality problems in these waters.

Oxygen depletion of the Spokane River occurs during summer low flows from the confluence of Hangman Creek to Nine Mile Reservoir. The dissolved oxygen content varies from 8 parts per million (PPM) to less than 4 PPM in the vicinity of the City treatment plant. Current state water quality standards for the river specify a minimum of 8 PPM throughout.

The influx of nutrients from runoff, waste discharge, and combined sewer overflows into Long Lake has accelerated the eutrophic conditions of the lake. Increased productivity in the form of algal biomass is evident in the lake from late spring through the summer. Thermal stratification of the lake each spring along with this increased productivity further accelerates the oxygen depletion in the reservoir.

<u>Need to Intercept Interim Sewerage Systems</u>. The City of Spokane operates several interim wastewater treatment systems which have a limited functional life. These facilities need to be intercepted and incorporated with regional wastewater facilities. The critical facility which will require interception at an early date is the Ligerwood Lagoon serving the "Continental City" service area of the City of Spokane. This is a non-overflow type lagoon which has limited capacity to serve a growing area of the City.

Suburban Areas

Land Use Needs. Widespread and inexpensive availability of groundwater combined with the lack of constraint to provide community sewerage service has contributed to suburban sprawl and uncontrolled development. With the extensive freedom to develop land which is in no way constrained by the normal need to extend community water systems or sewerage systems, the pattern of development in the suburban Spokane area is typified by a scattering of development. This scattered development complicates the planning of orderly urbanization and results in an eventual inefficient utilization of the land, which compromises open space opportunities.

Wastewater Disposal Needs. Within the suburban and urbanizing areas of Metropolitan Spokane outside the City of Spokane, the single most important wastewater management need is to arrive at a clear conclusion with regard to a policy of providing or requiring community sewerage systems or continuing the policy which permits individual septic tank disposal. This critical policy decision cannot be made on the simple basis that there is or is not a clear violation of water quality standards. At the present time water being withdrawn from the primary Spokane aquifer consistently meets the U.S. Public Health Service Standard for potable water supply, a fact which is in part attributable to the very large dilution factor afforded by the Spokane aquifer. Task Report Section 608 describes in detail the evidence and mechanics of waste discharge to groundwater in the Spokane Valley area. The fact of wastewater recharge to this sole source domestic water supply raises

fundamental questions which are not satisfactorily answered by the existing potable water supply quality:

1. Is it wise to continue recycling the wastewater from a population of 88,000 to the sole potable water source of the Metropolitan Spokane Area without more certain control of input quality than can be achieved by the use of individual septic tanks?
2. Knowing that by the time damage to the groundwater becomes apparent that correction within any reasonable period of years is not possible, is the risk represented by this continued discharge worthwhile?
3. Shouldn't the greater burden of proof be placed on the septic tank user in locations over the aquifer to demonstrate to the regulatory agencies that this continued practice will not cause long term damage?
4. Shouldn't the same standards apply collectively to a large number of individual waste discharges as would apply to the same waste being collected and discharged by a municipal facility?

The answers to these questions suggest that there is a need to provide a more satisfactory and controllable means of wastewater disposal for the large unsewered urban and suburban areas of Metropolitan Spokane. There is need to recognize that the following policy concerning septic tank usage in other metropolitan areas of this country

is applicable to Metropolitan Spokane:

Septic tanks or other means of individual wastewater disposal in an urbanizing area are to be an interim solution permitted only when physical, legal and other arrangements for a public or private sewerage utility are made a condition to development or occupancy of the land.

Need for Agency Control of Wastewater Disposal. Responsible agency control of all wastewater discharges is a currently unsatisfied need required to provide optimum protection of public health. Present policies permit individual owners of septic tank disposal systems to determine when and whether to pump accumulated sludge and whether to correct failures which are not otherwise brought to the attention of local health authorities. The City of Spokane provides public agency septic tank pumpage service but does not have a program of mandatory pumping or scheduled inspection and licensing. The Spokane County Health District administers septic tank construction permits and supervises septic tank installation but does not thereafter assume any authority over operations unless required to do so or if advised of an apparent public health hazard. There is no system of individual discharge permits or any program for required periodic maintenance and inspection.

Need for Agency Control of Septic Tank Pumpage Treatment and Disposal. Provisions for adequate treatment and disposal of septic tank sludge constitutes a serious existing need and one which will become increasingly critical if there is a continued deferment of sewerage facilities construction. At the present time the City of Spokane provides for septic tank sludge pumpage treatment. The City properly

requires that sludge be delivered by truck for direct discharge to the treatment plant which is a long costly haul from areas located outside the City and represents an inefficient expenditure of energy for delivery. This condition encourages illegal discharges to the City sewer system or the dumping of sludge on land at convenient but uncontrolled locations. An attempt to commercially operate a septic tank pumpage treatment plant to serve the septic tank pumping services in the Spokane area has failed both operationally and financially. There is a need to provide a septic tank pumpage treatment service to the outlying areas of Metropolitan and rural Spokane which would be more accessible and economical than the City plant, particularly to serve Spokane Valley and the easterly portions of the county.

Need to Intercept Interim Sewerage Systems. There are a number of interim wastewater treatment facilities throughout the urban and suburban areas outside the City of Spokane operated by Spokane County, other agencies and by private owners. These are described in detail in Task Report 311. As with similar facilities in the City, there is a need that these systems be intercepted within a reasonable period of time by a regional system. This existing need is projected to become more critical with time as facilities reach their reasonable economic life and capacity.

Independent Communities Wastewater Needs

The primary and almost universal unmet need found in the small outlying communities of the area is the total lack of adequate record

keeping or testing of plant operation. Almost none of the small communities have flow measuring devices, and none have any routine quality monitoring program. Refer to Section 311 and Section 312 for a complete discussion of the treatment facilities mentioned in the following section.

Newman Lake. There is an existing need to protect lake water quality from degradation by septic tank drainfield leachate and other urban wastes. The projected need becomes more critical in proportion to shoreline development and activity. The shallow nature of the lake causes it to be particularly susceptible to algal and weed growths.

Liberty Lake. See comment above. The projected need for Liberty Lake is expected to be substantially satisfied by implementation of improvements being proposed by the recently formed sewer district.

Unsewered Small Communities. The following small communities exceed 200 population and have no community wastewater facilities. Existing and projected growth indicate that there is a need to provide community systems:

Airway Heights
Camp Diamond (Pend Oreille Co.)
Chatteroy Hills
Four Lakes
Latah
Spangle
Stonelodge (Stevens Co.)
Mead
Nine Mile Falls

Small Community Wastewater Treatment Improvement Needs. The following communities have existing wastewater collection systems and

treatment facilities which provide nominal secondary treatment but which will require various improvements to meet the secondary treatment provisions of PL 92-500 by year 1977:

Community	Treatment Facility
City of Cheney	Lagoon
City of Deer Park	Trickling Filter
Fairchild A.F.B.	Trickling Filter
Town of Medical Lake	Lagoon
Town of Fairfield	Lagoon
Town of Millwood	Activated Sludge (Extended Aeration)
Town of Rockford	Lagoon
City of Tekoa	Primary
Wellpinit (BIA)	Activated Sludge (Extended Aeration)

It is expected that requirements for some of these small discharges will be amended in recognition of the minimal quantitative affect on the environment represented by literal discrepancies in meeting discharge standards. With the exception of Fairchild AFB, all of these facilities would benefit most from improvements which would provide for greater reliability and controllability of operations.

Cheney. The lagoon system is in general need of repair. Recently a lagoon dike failed, spilling large amounts of sewage to the adjacent land and drainageways. Wastewater treatment quality is very poor. The effluent quality when measured was poorer than the influent. There is a serious weed problem in the lagoons. The effluent flow route is not precisely known, but it closely follows the Burlington Northern railroad track. There are serious storm water overloads of the sanitary sewer system, mostly due to numerous roof drain connections. Urban runoff is simply diverted outside the City. There is a need for a

routine effluent quantity/quality monitoring program.

Deer Park. The sewer system is subject to high levels of infiltration. The treatment plant has ice problems in winter, trickling filter spreading arm clogging, poor digestor mixing, and is generally poorly maintained. The effluent is noticeably turbid. The urban runoff path is also not mapped. There is need of a routine effluent quantity/quality monitoring program.

Medical Lake. Infiltration is a problem with Medical Lake's sewers and the lagoons have a poor solids removal efficiency. There is need for routine effluent quantity/quality monitoring.

Fairfield. The sewer system drains a natural spring and consequently infiltration is high. The sewer system is poorly maintained. The lagoons exhibit poor solids removal efficiency. There is need of a routine effluent quantity/quality monitoring.

Millwood. Treatment plant operation needs improvement. Excess activated sludge in aeration tanks indicates that waste sludge is not being removed. Sewer system has some infiltration. There is need of a routine effluent quantity/quality monitoring program.

Rockford. Sewer system infiltration is a problem. Surface runoff enters the system during the spring thaw. There is a considerable weed problem in the lagoons. There is need of a routine effluent quantity/quality monitoring program.

Tekoa. The trickling filter plant is poorly maintained to the point of neglect. The comminutor and trickling filter units are not operative. Currently the plant operates as a very poor primary plant.

Planning is in progress to improve the plant. The plant site is situated within the flood plain, and it has been completely flooded. There is a need of routine effluent quantity/quality monitoring.

Wellpinit. This small lagoon system is subject to weed problems. Also, the headworks of the plant appear to be in need of repair maintenance. Quality of operation is not good. There is a need of routine effluent quantity/quality monitoring.

Industrial Wastes Needs

There is a greater amount of industrial wastewater being returned to the Spokane River than domestic wastewater. There is a need to control this source of pollution, including thermal pollution. The major discharge returns of wastewater to the Spokane River are cooling water discharges which contain low levels of contaminants but which are returned at a temperature higher than the initial diversion. Impact of this practice is to add to the pollutant loading of the river and to contribute to the critical rise in temperature which affects fisheries and which contributes to higher temperature in Long Lake, which is the most critical parameter relative to bio-mass production in that lake.

The two most prevalent examples of industrial wastewater mismanagement consists of high uses of once-through cooling water and the mixing of spent cooling water with sanitary and process wastes. Most industries utilizing cooling water in the study area were found to handle cooling water in this manner. Recycling of uncontaminated cooling water reduces the overall industrial water demand.

There is a significant amount of industrial wastewater being discharged to the primary aquifer. Heavy metals and other constituents of industrial waste are being introduced to permeable soil above the primary aquifer. The need to curtail this practice will be dependent on discharge location, levels of waste loadings, and results of further groundwater quality monitoring.

There is a need to provide for improved industrial wastewater monitoring. In order to more fully assess impacts of industrial wastes, which are subject to wide variations and to operations which are not subject to public observation, it is necessary to have access to more detailed flow and quality data than is now available. This is a very complex problem involving privacy and security of manufacturing processes, as well as the high cost of flow and quality measurement.

The following is a listing of the industries discharging to surface waters, and their associated unmet waste treatment needs.

Hillyard Processing (Sullivan).

Water use:	Washing Aluminum dross
Treatment:	Settling and pH adjustment
Problems:	High NH_3, Cl , TS, TDS, and some Heavy Metals in effluent
Unmet needs:	Higher level of treatment such as chemical coagulation to remove solids and metals and biological assimilation or NH_3 stripping to remove NH_3 should be considered.

Inland Empire Paper.

Water use:	Pulp and Paper processing, cooling
Treatment:	Essentially primary treatment
Problems:	No reuse or separation of spent cooling water. High BOD and Zinc in effluent; however, Zinc is no longer used in the bleaching process, thus eliminating any Zinc discharge in the future.
Unmet needs:	Separation and recycling of spent cooling waters should be practiced. Secondary treatment to remove BOD.

Kaiser (South Mead)

Water use:	Sanitary cooling
Treatment:	Percolation Lagoon
Problem:	Unnecessary and continuous pumping of unneeded amounts of water. Direct "once through" use of cooling water.

Kaiser (Mead)

Water use:	Cooling, sanitary, and water softener regeneration
Treatment:	Secondary for sanitary wastes, none for cooling and water softener backwash waste.
Problems:	No reuse or separation of spent cooling water. High Cl , Zn, and temperature in effluent.
Unmet needs:	Separate cooling waste from water softener backwash waste, and recycle cooling water. Reduce temperature of spent cooling water. Reduce Zinc in effluent by methods such as ion exchange or chemical coagulation.

Kaiser (Trentwood)

Water use:	Cooling, sanitary, metal cleaning, painting, rolling.
Treatment:	Secondary treatment for sanitary wastes, heat and acid treatment for oil wastes, coagulation for PO_4 and Cr wastes. Final lagoon stabilization for all wastes prior to discharge.
Problems:	No recycling or separation of cooling wastes.
Unmet needs:	Separate and recycle spent cooling water.

Culligan Soft Water Service

Water use:	Regeneration of water softeners
Treatment:	pH adjustment
Problems:	High dissolved solids in effluent
Unmet needs:	Filtration and chemical coagulation of effluent should be considered. Reuse of effluent can be practical with adequate treatment.

Spokane Industrial Park

Water use:	Sanitary, cooling, and various process needs
Treatment:	Secondary treatment
Problem:	High concentration of heavy metals and oil and grease in effluent
Unmet needs:	Higher level of grease removal plus chemical coagulation to remove heavy metals should be considered. Pretreatment facilities for major tenant industries can also be considered.

There are relatively few unmet needs for most small industries that discharge to the groundwater. These industries generally have low flows and comparatively mild wastes. Treatment by percolation and evaporation are normally considered satisfactory. One industry, Rockford Grain Growers, discharges small volumes of fertilizer and pesticide wastes to a lagoon. This constitutes a potential threat to the groundwater in the vicinity.

Projected Wastewater Needs

The projected needs for the management and control of wastewater are identical to the needs previously described, but as compounded by the impact of increased population. Population forecasts for the Metropolitan Spokane Area are contained in Task Report 402, "Population Forecasts, Spokane and Adjoining Counties". The distribution of forecast population and related land use forecasts are contained in Task Report 403, "Projected Population Allocation and Land Use Forecast in the Urban Planning Area". Waste load projections distributed by incremental planning areas, described in Task Report 602, "Wastewater Planning Units", are described in detail in Task Report 406.2, "Projected Waste Flows and Pollution Loads, Urban Planning Area", which is based on criteria described in Task Report 406.1, "Criteria for Projection of Waste Loads". These projections of waste loads are allocated according to land use categories relating to industrial, commercial and residential loads.

Flood Control Needs

Existing and projected flood control needs are described in

detail in Task Report 604.6, "Flood Control Needs, Alternatives, and Evaluation". The following is a summary of these needs.

Spokane River Flood Control Needs. The flood control needs of the Spokane River are localized to a few points of specific flood damage under existing conditions at relatively high river stages. This means that flood exposure is limited in frequency and in its extent. Under projected conditions, a few locations of limited area adjacent to the main channel have been identified in the flood plain delineation described in Task Report 410.2 which are currently undeveloped and which should be protected from encroachment under projected land use conditions.

There is a need to control flooding of the Spokane River at the following locations, the extent of which and added detail are described in Task Report 604.6. These are:

Peaceful Valley @ R.M. 73.6
Vicinity of Trent Street Bridge @ R.M. 75.5 to 76.2
Upriver Drive @ R.M. 76.8 to 78.0

Little Spokane River Flood Control Needs. Flooding within the confinement of the Little Spokane River Valley is a fairly routine and natural phenomenon which occurs almost every year to varying degrees. There is some question whether such a frequent occurrence should be termed "flooding" or whether it might better be described as the river exceeding its low flow channel capacity and utilizing its natural high flow channel. This pheonomenon is described in greater detail in Task Report 604.6.

The following development is affected by flooding of the Little Spokane River:

Fairwood sewage treatment facilities
Several residences near Dartford
Several residences near Buckeye

Projected land use conditions are not expected to modify the flood flow characteristics of the Little Spokane River significantly. Future development should be excluded from the natural high flow river channel as a means of limiting flood control needs in the future.

Hangman Creek Flood Control Needs. Hangman Creek (Latah Cr.) is subject to sudden extremes in flow which can cause overbank flow in an extensive area, most of which is rural land. There are few improvements which are affected by this flooding. This flood plain is delineated in Task Report 410.2 and detailed flood control needs are discussed in Task Report 604.6.

The extent of flood control needs in existing developed areas is as follows:

29th and Oak @ R.M. 2.9 to 3.2
Hangman Valley Golf Course @ R.M. 14.4

There is an associated need to Hangman Creek flooding which is probably more serious than the flood waters and that is the need associated with the heavy siltation caused by runoff from bare Palouse soils which call for radically improved agricultural practices in this area if water quality objectives are to be considered.

Rock Creek at Rockford. The Town of Rockford is partially protected from flooding by a levee system on Rock Creek which is in need of improvement. The existing levee is of inadequate height and length to afford a high level of flood protection. Structural quality of sections of the levee is questionable. Penetrations of the levee, carelessly attended, have permitted avoidable flooding. Refer to detailed description in Task Reort 604.6.

Water Resources and Water Systems Needs

General. The Spokane region benefits from ample water resources under existing conditions and undeveloped water resources reserves which are more than adequate for projected needs. Water resources quantitative needs primarily relate to the needs for distribution of water to those areas located at significant distances away from the Spokane River and the valley aquifers. Those lands situated on the basalt plateaus are substantially deprived of immediately accessible water; that which is available is subject to poor quality.

The critical water resource need is to protect water quality from further degradation and to improve water quality where degradation has already occurred. The need to protect groundwater quality is of major importance inasmuch as almost all domestic water use in the Spokane area depends on groundwater.

There is a need to improve the efficiency of water distribution both from the point of view of simplifying the organization of

distributing agencies and also to encourage policies which will reduce wastage of water even though it is in plentiful supply.

Groundwater Resources Needs

Primary Spokane Aquifer. Essentially all of the Metropolitan Spokane area utilizes the primary Spokane aquifer for domestic water supply. This aquifer is subject to pollution resulting from the various activities of the people who live above it and discharge wastes to the ground. Present water quality meets U.S. Public Health Service Drinking Water Standards but does show a degradation relative to intensity of surface activity. Projected water quality conditions have been evaluated and indicate a trend towards more serious degradation and potential violation of nitrate standards under future development conditions.

With the anticipated future intensive development of the Spokane aquifer in the Rathdrum Prairie area, it is expected that projected conditions may be increasingly vulnerable to water quality problems as withdrawals reduce available dilution flows. Probably the most important water resources management need of the Spokane area is the need to protect the quality of Spokane groundwater.

Basalt Aquifers. The rimrock and plateau basalt aquifers are limited to the storage capacity of rock fracture zones and are limited to recharge by direct precipitation. These rock fractures are very susceptible to contamination which may be directly piped via these fractures. Water quality data in the basalt aquifer areas indicates this vulnerability to contamination as indicated by a relatively

persistent detection of coliform bacteria in areas served by the basalt aquifers. There is a general need to provide supplemental water resources to those areas now dependent on basalt aquifers. The basalt aquifer is inadequate to provide service to other than the smaller rural communities. Augmentation of supplies in several areas appears to be necessary to support existing as well an anticipated population growth.

Surface Water Resources Needs

The existing development of the surface water resources of the basin is substantially limited to power generation, cooling, water utilization, and limited agricultural irrigation. Because of the availability of excellent supplies of groundwater in most of the urbanizing portions of the basin, there is a very limited need to consider development of the surface water resource for use in the Metropolitan Spokane planning area.

There is a need or, more correctly, the opportunity to consider means by which the natural interflow from surface water to groundwater can be augmented as one means of improving both groundwater quantity and quality. This need becomes more significant under conditions of projected development.

Groundwater Quality Protection Need

The City of Spokane's primary source of domestic water supply is groundwater which is withdrawn from wells, all of which are generally located downstream from urban development in Spokane Valley which discharges wastewater to the ground over the primary aquifer. The City is

concerned with the need to protect the quality of this groundwater against harmful degradation which could require the City to relocate its point of main withdrawal or provide treatment. There is not a demonstrated violation of minimum drinking water standards at this time nor is it possible to state with certainty that a violation of standards may develop under projected conditions. A conservative cautionary policy, as has been traditionally established in this country, would suggest that this concern is sufficiently well defined to establish a need to remove the source of pollutants to this aquifer. An assessment of this need under projected conditions should also consider possible amendments to drinking water standards concerning such constituents as dissolved organics, the health significance of which is receiving considerable research attention at this time.

There is an existing population of 88,000 persons within the metropolitan area which discharges domestic sewage and other wastewater to the ground overlying the primary source of water supply for metropolitan Spokane. The impact of this condition is reflected in existing water quality degradation of the primary aquifer and the potential of serious public health problems. Maintenance of this spectacular resource of the Spokane area is also important to the economic potential of the area, which will be increasingly recognized for this asset as water resources for industrial and domestic purposes in other areas of the country become increasingly degraded. The quality of water available to Spokane should not be jeopardized due to the failure to recognize the impact of careless waste disposal practices or the attitude that this is an unlimited resource.

Water Distribution Systems Needs

Multiple Operating Agencies. There are 46 independent water service agencies within the study area. There are 65 separate water systems containing 96 separate distribution pressure zones. This proliferation of water agencies is made possible by the wide availability of economical water from the primary aquifer. With so many agencies responsible for water distribution, the problem of providing for regulation of public health requirements and for effectively encouraging or requiring water conservation and most efficient utilization of such an easily accessible resource are very complex. It appears possible that coordination of systems could improve operation efficiency, provide more reliable water service, and would improve fire protection and fire insurance rate benefits particularly. It should be noted that the City of Spokane, which is substantially the largest water agency, is the only agency without significant deficiencies in certain areas of water service capability.

This need for simplification and unification of water distribution administration will become increasingly significant under projected conditions.

Disinfection Needs. Fifty of the 65 water systems lack disinfection facilities. The general absence of chlorination facilities, except for the City of Spokane system, is one of the major general deficiencies of water systems in the area, particularly since sewage is

being discharged to the porous ground immediately over the water source of these systems and in the immediate vicinity of distribution pipelines.

Cross Connection Control Needs. Forty-nine water systems have cross connection deficiencies. As with the lack of disinfection facilities, the systems outside the City of Spokane, and to only a limited extent the City of Spokane, lack adequate enforcement of normal backflow prevention practices. Public water supplies, in addition to being chlorinated, should be protected from contamination from potential direct connections to polluted water sources which may relate to either industrial or domestic uses. The use of backflow prevention check valves, air gaps, and vacuum relief valves should be required where there is any possible source of cross connection pollution.

Fire Flow Needs. Twenty-five water systems utilize main sizes of less than 6-inch diameter. The utilization of undersized water mains affects primarily the capability of a water system to provide fire protection, and in many locations limits the ability of a system to provide peak use period service at an adequate pressure. This common deficiency in many systems is reflected in fire rating criteria which discount the value of any fire hydrant served by less than a 6-inch main. Under projected land use conditions, as undersized mains are extended, this need becomes more acute.

Emergency Power Capability Needs. Fifty-two water systems have inadequate standby power. Water systems without either adequate storage or alternate sources of power will result in lack of water service during extended power outages, which may occur at a time of

emergency when water may be needed.

An example of this need can be taken from the history of Spokane. The great fire of 1889 was permitted to spread and eventually destroyed the City because of failure of the water system due to power and pumpage failure.

This need is expected to be less critical under projected conditions as water systems expand and develop added pumping and storage capacity. The expected increase in unification of systems will also provide greater reliability and system flexibility as a result of distribution network expansion and diversification of sources and transmission lines.

Needs of Systems with Inadequate Sources. Eighteen water systems have an inadequate source of water. Those systems dependent on basalt wells are very limited. The basalt aquifers recharge very slowly with the result that many communities dependent on these sources of water are in a sense mining their water resource, a practice which will result in eventual depletion to levels which can be supported by limited recharge. These basalt aquifers, due to the direct connection afforded by rock fractures, are also vulnerable to surface pollution.

Under projected conditions this need becomes more critical in those areas where groundwater use exceeds recharge capacity, or where groundwater "mining" is common practice.

Pumping Capacity Needs. Twenty-nine water systems have inadequate pumping capacity. These systems are only marginally adequate to meet peak daily flow demands and must depend on storage depletion

to meet peaking requirements. This practice depletes effective storage which is also needed for fire protection.

This need becomes more critical under projected conditions unless pumping and/or storage facilities are added.

Storage Capacity Needs. Twenty-one water systems have less than minimum desirable storage capacity. These systems, many of which were initially designed for irrigation service, provide less storage than is desirable for normal domestic service. Many depend on pump pressurization to maintain system pressure which makes those systems particularly vulnerable to power outage.

This need becomes more critical under projected conditions unless storage facilities are added.

Combined Storage/Pumping Needs. Twelve water systems have inadequate combined storage plus pumping capacity. This deficiency relates to the combined effects of pumping and storage capacity needs. This estimate of the number of deficiencies does not reflect the fact that many more systems have less than optimum capacity in this regard.

This need becomes more critical under projected conditions unless reliable pumping and/or storage facilities are added.

Pump Outage Capability Needs. Thirty-one water systems cannot withstand a 24-hour pump outage. This is a critical evaluation which considers the consequence of the combined storage and standby power capabilities of water systems. These systems afford inadequate domestic use or fire protection.

Projected Water System Needs

The projected needs for water supply and distribution are identical to the needs previously described but as compounded by the impact of increased population. Population forecasts for the Metropolitan Spokane Area are contained in Task Report 402, "Population Forecasts, Spokane and Adjoining Counties". The distribution of forecast population and related land use forecasts are contained in Task Report 403, "Projected Population Allocation and Land Use Forecast in the Urban Planning Area". Consumptive water demand forecasts have been developed and are related to the above forecasts of population and land use. Projected water demand is described in detail in Task Report 407, "Projected Water Use". These projections of water use are described in terms of allocation to domestic, commercial, industrial and agricultural utilization with regional allocations based on forecast land use.

Urban Runoff Needs

General. Urban runoff needs are discussed in detail in Task Report 604.5 in reference to both water quality and local flooding relief needs.

City of Spokane Urban Runoff Needs. Water quality problems associated with urban runoff in the City of Spokane involve surface contaminants which are washed off by surface runoff and, more critically, the effects of combined sewer backups and overflow bypass which have been previously described.

There is a most critical need for separation or adequate treatment of combined wastewater-urban runoff flows in the City of Spokane.

There is a need to provide increased storm flow capacity in critical locations of the City where there exists a high exposure to damage from high intensity summer storms.

There is a particularly serious need to provide separate conveyance for storm water in those areas of the City where combined sewage flow causes backup of sewage into basements.

North Spokane Urban Runoff Needs. The North Spokane area urban runoff is conveyed to the north to the Little Spokane River by a surface drainage channel with constricted capacity at several locations. There is a need to provide for existing storm runoff flow needs and to plan for projected conditions recognizing the substantial increase in impervious surface which will be associated with anticipated development.

There is a need for improved hydrologic data in order to

provide a better basis for facilities design. There is a need to measure flow and localized precipitation for significant storm events.

Spokane Valley Urban Runoff Needs. Spokane Valley urban runoff is conveyed to percolation disposal. The major urban runoff need in Spokane Valley is to establish a workable plan and policies for providing drainage systems for valley rim developments which increase runoff onto the valley floor in concentrations which exceed natural conditions and which cause localized flooding problems.

Projected Urban Runoff Needs are substantially identical with the needs described above but compounded substantially in proportion to the increased pressures of population and land use as forecast in Task Reports 402 and 403. With the adoption of policies requiring the separation of sanitary and urban runoff flows, the problem of combined flows is not expected to become any more intense than at the present time. The primary increase in urban runoff impact under projected conditions will occur in the North Spokane area with the potential development of Five Mile Plateau. This projected increase in impervious surface area and related increase in runoff is considered in the development of URO plan alternatives as described in Task Report 604.5, "Formulation and Evaluation of Alternative Plans for Urban Runoff Management".

TABLE 1
SUMMARY OF
MAJOR UNMET NEEDS

Wastewater Management	Flood Control	Water Supply	Urban Runoff
Satisfy Federal and State Requirements	Reduce Existing Flood Damage Potential	Protect Groundwater Quality	Prevent Combined Sewer Overflow
Prevent Combined Sewer Overflow	Prevent Flood Plain Encroachment	Simplify Distribution Management	Stormwater Separation
Protect Groundwater Quality		Provide Residual Disinfection	Increase North Spokane System Capacity
Improve Surface Water Quality		Augment Basalt Aquifer Supplies	Protect or Augment Percolation Sites in Spokane Valley
Meet Sewerage Facilities Growth Demand		Improve Storage and Distribution Capacity	
Provide Sewers in Unsewered Urban Areas		Control Cross Connection	
Intercept Interim Systems		Improve Fire Flow	
Need for Agency Control of Wastewater Disposal			

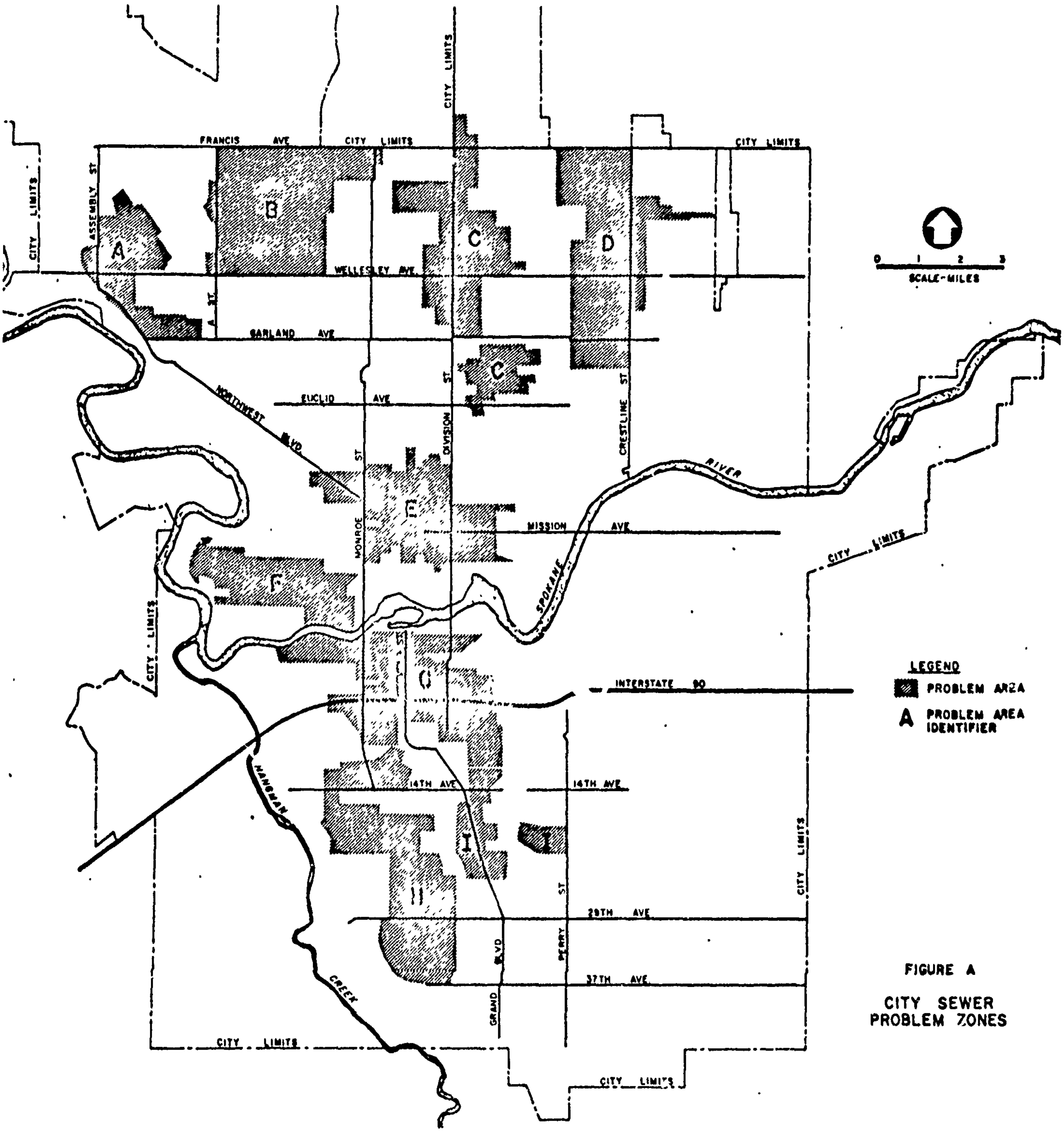
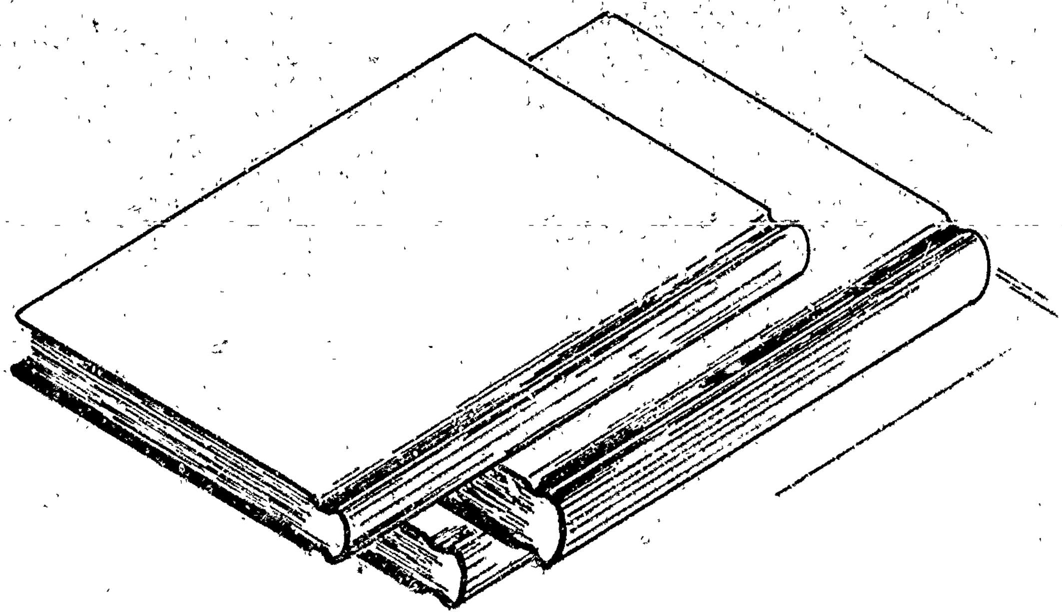


FIGURE A

CITY SEWER PROBLEM ZONES



SECTION 602

WASTEWATER PLANNING UNITS

WATER RESOURCES STUDY

METROPOLITAN SPOKANE REGION

SECTION 602

WASTEWATER PLANNING UNITS

16 October 1974

Department of the Army, Seattle District
Corps of Engineers
Kennedy-Tudor Consulting Engineers

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* All plates are large drawings bound at the end of this section.

SECTION 602

WASTEWATER PLANNING AREAS

Introduction

For the urban planning portion of the study area the primary objectives of this section are to select geographical planning units on which to base waste load projections for the formulation of alternative wastewater management plans. These planning units are to serve as building blocks for the assembly of wastewater sources into alternative management groups.

For the remainder of the study area the basic wastewater planning unit is established by the state Water Resources Inventory Area (WRIA). Within each WRIA the planning elements selected are the individual communities.

As a first step toward establishing planning units, an initial objective is selection of criteria for the makeup of a planning unit.

Criteria for Planning Units

The basic element of a wastewater planning unit is that it be a feasible collection unit. It is not necessarily restricted to a natural topographic drainage unit, although this is the feature that usually makes an element a feasible collection unit. Other considerations such as land use and growth patterns and ultimate population density

must also be considered. It may be reasonable to include an adjoining area not topographically tributary if its land use and existing or projected development are compatible.

Existing collection systems and political boundaries must also be considered. For example, parts of the City of Spokane have been made tributary to the existing treatment plant although their natural drainage is toward adjoining lowlands outside the City. Presently unsewered areas of the City which drain outside the City must be considered a potential City service area, despite topography, due to the City obligation to provide service.

It is desirable to make the planning units as large as possible consistent with the planning objectives. Feasible collection units need not be further subdivided unless they contain widely separated areas of development or are developing in such a pattern that the normal internal collection system would not deliver the collected wastes to the natural point of concentration of the tributary area. Normal internal collection systems are not a part of cost effectiveness comparisons since they are common to all alternatives. Trunk systems used to collect two or more planning units as an element of an alternative plan are considered as an element of cost-effectiveness. This requirement must be considered in delineation of planning units.

The WRIA boundaries within the urban planning area are a crude delineation of the natural topographic drainage. As indicated above, natural topographic drainage is only one of several elements that must

be considered in wastewater management planning. Consideration of the urban planning area as a unit is given preference over the artificial subdivision of that area which would be necessary to follow WRIA boundaries. Outside the urban planning area, the WRIA boundaries become realistic natural boundaries of planning units.

Selection of Planning Units

City of Spokane. The political boundaries of the City of Spokane include areas that fall in the following categories:

1. Developed and sewered
2. Developed and unsewered
3. Undeveloped and unsewered

The developed and sewered area is selected as a planning unit because it is presently operated as such and is committed to a long range improvement for its treatment facility under the direction of DOE. The existing sewage collection system consists of ten subcollection systems which are delineated in Esvelt & Saxton-Bovay(1972). Where further subdivision of the City is necessary these existing subcollection service areas are available and are appropriate planning tools, either individually or in groupings.

The developed and unsewered and the undeveloped and unsewered areas of the City on the periphery of the sewered area are considered individually as to their relation to the City and the adjoining area.

The northwest corner of the City is a natural topographic unit

sloping from Five Mile Prairie to the Spokane River. A ridge which approximates the north City Boundary separates the drainage of this area from that which slopes toward the Little Spokane River. It would also mark the approximate WRIA boundary. The area is presently only lightly developed except for the concentrations at Northwest Terrace, Pacific Park and Sundance Hills which are served by interim facilities. This entire area is made a single unit designated NS-1. Refer to Plate 602-1.

The City limits contain two other tongues of unsewered land north of Francis Avenue. One includes the southeast quarter of Five Mile Prairie and the other is on the plain east of, but separated from, Five Mile Prairie. Five Mile Prairie as a whole is selected as a planning unit, including the one-fourth presently within the City, due to its uniform and isolated character. The City area east of Five Mile Prairie is substantially of the same rapidly growing suburban residential type as the unincorporated area between it and Five Mile Prairie and both drain northward toward the Little Spokane River. Therefore, this part of the City is included with the adjoining unincorporated area in planning unit NS-3.

At the northeast corner of the City there is an unsewered area of the City that is separated from the City on its west side by the Burlington Northern railroad yards which are in unincorporated land and on the south by the Esmeralda Golf Course (Municipal). The area drains to the north. This City area is joined with similar adjoining unincorporated area north of the City, to which it is topographically tributary, in planning unit NS-4.

The southeast corner of the City is unsewered because it drains in a southeasterly direction away from the remainder of the sewered area south of the river. Moran Prairie, south of the City, belongs in the same drainage system. These areas are combined into a single planning unit designated Moran Prairie. An additional unifying feature in this area is water service from the City of Spokane system.

The southwest boundary of the sewer service area south of 17th avenue is formed by the edge of the bluff along the east bank of Hangman Creek (High Drive and High Drive Parkway). The potential development in this part of the City is all west of and separated from the rest of the City by Hangman Creek. The area is similar in character and drainage to the adjoining unincorporated area which extends westward to Spokane International Airport and south to Geiger Heights military housing, served by City water system. The City area and adjoining unincorporated areas are combined in a planning unit designated Southwest.

Spokane Valley. The entire urban planning area east of the City limits except Orchard Prairie on the north and Moran Prairie on the south is designated the Spokane Valley planning unit. The first step undertaken to divide this area into sub-planning units is to define the natural drainage areas. Except for the lands immediately adjacent to the river, the valley floor drainage is parallel to the river rather than toward it. There is a ridge beginning in the Orchard Avenue area which parallels the river eastward to Millwood and beyond to the south bank opposite the Kaiser Trentwood works to near Veradale. The freeway, I-90, in general

follows this high ground. Paralleling this ridge and south of it is a well defined swale draining from Greenacres through Veradale, Opportunity and Dishman, thence turning northwesterly to cross the freeway and meet the river in the vicinity of Felts Field. The drainage becomes very indefinite as it nears the river, the point of concentration could be anywhere from Felts Field to Havana Street. The highly permeable soils of the area prevent the formation of any extensive natural surface drainage courses which normally define drainage without question.

The above described swale which more or less follows Broadway and Sprague Avenue is defined on the south by another ridge parallel to the river about at 12th Avenue. This creates a second parallel swale between 12th Avenue and the south foothills of the valley proper. This second swale likewise turns north at its eastern end to follow the Dishman-Mica Road to Dishman where it joins the first swale described above. These two swales parallel to the river contain most of the existing valley developement south of the freeway.

The second swale has its own natural limits being surrounded on three sides by the foothills and on the fourth by the ridge along 12th Avenue. The limit at the point of concentration along the Dishman-Mica highway is selected at 8th Avenue, just north of University High School. This sub-planning unit is designated SV-4. It is an area in which urbanization is well advanced and seems to be following an established pattern.

The first swale, the Broadway-Sprague drainage, actually continues eastward beyond Veradale. There is at that point a definite decrease

in existing development. Therefore, Sullivan Road is selected as the eastern limit of this subplanning unit. The City sewer service boundary is selected as the western limit and the area designated SV-3. This sub-planning unit is relatively homogeneous residential suburban type development east of Fancher Road and south of Sprague Avenue. An industrial area is contained in the area bounded by Fancher, Sprague, Havana (City limits) and Trent Avenue. It is not considered necessary to define this industrial area as a separate sub-planning unit so long as it is recognized and its properties incorporated into the sub-planning unit totals.

The areas immediately adjacent to the river containing Pasadena Park on the north and Millwood on the south make up natural topographic units. The area north of the river is naturally limited on the east by the foothills which come right to the river at that point. The Pasadena Park area, designated SV-1, is relatively unique in the character of development containing very large lots with garden and pasture and having an extremely high per capita water consumption. The Millwood area, designated SV-2, is an older community with smaller lots and lower per capita water use. The east boundary is selected at Pines road since this is a clear break as the eastern limit of development centered on Millwood.

East of Pines Road there is a continuing strip of land north of the freeway that is tributary to the river. It is essentially undeveloped east to Flora Road. From Flora Road east to Barker Road there is an area of development, some of which, in trailer parks, is quite intensive. Beyond Barker Road south of the river, land use is essentially agricultural. The area between I-90 and the river and from Pines Road to Barker Road is

designated subplanning unit SV-6.

South of the freeway east of Sullivan Road less intensive development follows the Sprague Avenue drainage eastward to a little beyond Barker Road where, again, the land use becomes agricultural. The areas south of I-90 to the foothills and from Sullivan Road to Barker Road, and extending along the Milwaukee RR an additional mile is designated subplanning unit SV-5.

Units SV-5 and SV-6 are estimated to be the eastern limits of development which will achieve a density that could make sewers feasible.

North of the river, the Trentwood area which drains southwesterly toward the river, makes another natural sub-planning unit with Newman Lake Road forming a ridge line along the southern boundary. The eastern edge of existing development extends slightly beyond Sullivan Road but the more intensive development extends only to Progress Road which is selected as the eastern boundary of unit SV-10.

The industrial area including the Kaiser Trentwood works and Spokane Industrial Park occupies the area between Newman Lake Road and the river east to Flora Road. This area slopes southwesterly to the river. East of Flora Road existing residential development is sparse except for a heavy concentration of mobile homes in the vicinity of Sullivan Road on the north bank of the river. The essentially open character extends east to Campbell Road which appears to mark the western boundary of the rather uniform but low density development centered on Otis Orchards. Campbell

Road is selected as the eastern boundary of sub-unit SV-9 whose principal component is the industrial area west of Flora Road.

The remaining areas of the Spokane Valley in the urbanizing area are the portion north of the river and east of Campbell Road and that south of the river east of Sullivan Road. Both areas are predominantly agricultural and are forecast to remain substantially of that character to year 2020. The area north of the river contains two kinds of residential development; the low density semi-rural development on the valley floor around Otis Orchards, and the more concentrated non-agricultural residential development along the shores of Newman Lake. South of the river the only residential development is that concentrated along the shores of Liberty Lake. For the purpose of regional planning there is no need to subdivide these two areas further. They are designated SV-8, north of the river, and SV-7, south of the river. It is recognized that the concentrations adjacent to both lakes pose special problems that must be addressed separately. The tools available for this are developed from the SMATS zones, 278 for Newman Lake and 374-375 for Liberty Lake which provide population projections for these local areas. In effect, Newman Lake and Liberty Lake are being designated as special sub-sub-units within SV-8 and SV-7 respectively.

North Spokane. The urbanizing area north of the City of Spokane extends to include portions on the north bank of the Little Spokane River and up the valley of the Little Spokane River to the vicinity of Colbert.

The area between Five Mile Prairie and the Spokane River has already been discussed above relative to the City in defining sub-unit NS-1. Five Mile Prairie, which is an isolated plateau approximately 300 feet above the surrounding valley floor, is also discussed in connection with City lands and is designated sub-unit NS-2.

The eastern edge of the tongue of City land between Nevada Street extended and Division Street forms an indistinct ridge which defines a natural drainage area between Nevada Street extended and the bluffs of Five Mile Prairie. The unincorporated area between Division Street and Five Mile Prairie is already heavily developed to city-like densities. The City area between Nevada Street and Division Street is less heavily built up and includes in the northernmost tip the Cozza-Caulkins lagoons which provide treatment for the City development. Hastings Road is selected as the northern limit of sub-unit NS-3 although the present highest density development ends at the electrical transmission right-of-way. There is another indistinct ridge line at Hastings Road which defines the sub-unit topographically.

There is another existing concentration of residential suburban development northeast of Mill Road in the next natural topographic sub-unit north of NS-3 which extends to the Little Spokane River. The western limit of this sub-unit is selected at the line between sections 11 and 12 (approximately the centerline of Five Mile Prairie extended) which is a natural topographic boundary as the slopes close on the river and includes the western limits of development. Since the existing development is at

the downstream end of this topographic unit there is potential flexibility in selecting the eastern or upstream end. The valley bottom on both sides of the river extending upstream to where Little Spokane Drive crosses the Little Spokane River is included in sub-unit NS-6. The limits of NS-6 consider the forecast growth rates. The intent is to incorporate in this planning sub-unit the areas forecast to have highest growth rates and to make the separation to put areas of lower growth rates in other sub-units. Sub-unit NS-6 as selected will have a growth of 4.7 times from 1970 to 2020. The areas excluded from NS-6 into NS-8 on the north and NS-9 on the east are forecast to have much lower growth and lower final density. NS-8 is forecast to increase 2.8 times and NS-9 is to increase 1.8 times.

Downstream from NS-6 to the confluence of the Little Spokane and Spokane Rivers, is a large area with a population of approximately 140 now, and is forecast to increase to only 397 in 2020. This area which is tributary to the Little Spokane River on both the north and south banks is left in one sub-unit designated NS-7.

The area northeast of the City forms a topographic unit which drains north easterly centered on a low which begins near the northeast corner of the City and generally follows the power transmission right-of-way to the Newport Highway. The upstream end of this area has already been discussed under City lands. An L shaped area including the unsewered City land east of the Burlington Northern RR yards and the unincorporated area north of the City are combined in sub-unit NS-4. These are both developed areas forecast to have only modest increased population, about 1.2 times

to 2020. The remainder of this topographic unit is very thinly developed residentially but contains two major industrial areas, the Kaiser Mead and Kaiser South Mead plants. The forecast residential growth is small. This essentially industrial sub-unit is designated NS-5.

Orchard Prairie. The Orchard Prairie area northeast of the City is included in the urban planning area although the area is essentially rural in character and is forecast to remain so. The present population is about 550 and the year 2020 forecast is 940. The topography divides the area into two portions, one that drains northeast toward Deadman Creek and one that drains toward sub-units NS-4 and NS-5. Due to the extremely low ultimate density it is not deemed necessary to subdivide the planning unit for these drainage subareas.

West Plateau. The urban planning area west of the City of Spokane extends to Brooks Road beyond Fairchild AFB. Fairchild AFB, because of its size and the fact that it provides its own water supply and waste disposal facilities, is designated a separate planning unit. Except for the Airways Heights vicinity, there are no significant population concentrations in the West Plateau area. The present overall population density is small and the forecast growth is likewise small, particularly to the year 2000. The growth forecast to year 2000 is 1.4 times but to 2020 is 2.0 times. Total population at year 2020 is only 4549.

Population Forecasts of Urban Areas Planning Units

Allocation of forecast populations is developed in Section 403 in terms of SMATS zones and districts. These data are reproduced in Appendix II of this section. The correlation between SMATS zones and planning units is tabulated in Appendix I. The forecasts of population for planning units and sub-units as developed from the materials in Appendices I and II are summarized in Table 1.

The growth rates for the various planning units are summarized in Table 2 and all population data are summarized in Plate 602-2.

Plate 602-3 shows the relationship of areas of population concentration at 1970 and at year 2020 in relation to the planning unit boundaries. Note how Plate 602-3 shows the focus of planning needs on sub-units SV-2, 3 and 4 in the Spokane Valley and on NS-1, 3, 4 and 6 in the North Spokane Area.

Table 3 presents population forecasts for the local areas around Newman Lake and Liberty Lake. These areas, although not designated as planning units, are areas of concern which are to be addressed separately.

Population Forecast of the Non-Urban Areas

The boundaries of the Water Resources Inventory Areas (WRIA) which delineate the planning units outside the urban planning area are shown on Figure A*. For non-urban areas, the population forecast is developed in Section 403.1. The forecast for non-urban areas is in terms of communi-

* Figure A herein is same as Figure A of Section 403.1

ties and rural areas by counties. Table 4 develops a population forecast adjusted to WRIA boundaries.

TABLE 1
POPULATION FORECASTS, PLANNING UNITS
OF URBAN PLANNING AREA

Planning Unit	Subunit	Forecast Population By Years 1970	1980	1985	1990	1995	2000	2020
NORTH SPOKANE	NS-1	1,031	1,507	3,093	4,759	6,375	8,000	13,922
	NS-2	759	896	1,666	2,474	3,282	4,097	7,189
	NS-3	11,090	14,555	16,257	18,044	19,693	21,358	25,120
	NS-4	2,596	2,754	2,785	2,818	2,863	2,910	3,146
	NS-5	169	1,139	1,156	1,174	1,216	1,261	1,437
	NS-6	1,205	2,730	4,411	6,177	7,919	9,670	12,669
	NS-7	114	165	187	209	243	277	397
	NS-8	276	312	374	441	509	579	887
	NS-9	1,522	2,113	2,286	2,465	2,686	2,910	3,718
Subtotal		18,762	26,171	32,215	38,561	44,786	51,062	68,485
SPOKANE VALLEY	SV-1	2,160	2,431	2,774	3,136	3,406	3,677	5,082
	SV-2	7,929	8,742	9,102	9,479	9,754	10,034	11,500
	SV-3	27,713	32.947	34,237	35,604	36,852	38,129	43,830
	SV-4	9,070	13,198	15,510	17,864	20,429	22,818	30,929
	SV-5	1,877	2,440	2,530	2,625	2,714	2,806	3,267
	SV-6	1,072	1,113	1,142	1,173	1,228	1,286	1,575
	SV-7	1,621	1,963	2,205	2,459	2,631	2,808	3,560
	SV-8	1,468	2,523	2,805	3,102	3,421	3,745	5,190
	SV-9	968	1,574	1,716	1,864	2,022	2,182	2,837
	SV-10	1,928	2,373	2,512	2,657	2,877	3,100	3,586
Subtotal		55,806	69,304	74,533	79,963	85,334	90,585	111,356
CITY OF SPOKANE(1)		167,495	177,660	179,101	180,639	182,328	184,073	192,962
MORAN PRAIRIE		3,575	5,530	6,404	7,320	8,307	9,298	12,949
SOUTHWEST		2,920	3,088	3,547	4,029	4,433	4,839	6,504
Subtotal		173,990	186,278	189,052	191,988	195,068	198,210	212,415
FAIRCHILD AFB		6,700	6,700	6,700	6,700	6,700	6,700	6,700
WEST PLATEAU		2,358	2,608	2,833	3,074	3,364	3,657	5,084
Subtotal		9,058	9,308	9,533	9,774	10,064	10,357	11,784
ORCHARD PRAIRIE		486	645	674	707	747	787	940
TOTAL URBAN PLANNING AREA		258,102	291,706	306,007	320,993	335,999	351,001	404,980

(1) Geographical area of present sewage collection system

TABLE 2

FORECAST POPULATION GROWTH RATE
URBAN PLANNING AREA

Planning Unit	1970-1980	1980-1985	1985-1990	1990-1995	1995-2000	2000-2020
	Forecast Average Annual Growth Rate, Percent By Periods					
North Spokane	3.9	4.6	3.9	3.2	2.8	1.7
Spokane Valley	2.4	1.5	1.5	1.3	1.2	1.2
City Sewered Area	0.6	0.2	0.2	0.2	0.2	0.2
Moran Prairie	5.5	3.2	2.9	2.7	2.4	2.0
Southwest	0.6	3.0	2.7	2.0	1.8	1.7
Fairchild AFB	0.0	0.0	0.0	0.0	0.0	0.0
West Plateau	1.1	1.7	1.7	1.9	1.7	2.0
Orchard Prairie	3.3	0.9	1.0	1.1	1.1	1.0
TOTAL URBAN AREA	1.3	1.0	1.0	0.9	0.9	0.8

TABLE 3

POPULATION FORECASTS OF
NEWMAN LAKE AND LIBERTY LAKE VICINITIES

	Forecast Population By Years						
AREA	1970	1980	1985	1990	1995	2000	2020
Newman Lake	159	162	311	468	630	792	1493
Liberty Lake	907	982	1164	1356	1467	1580	2097

TABLE 4
POPULATION FORECASTS OF
NON-URBAN PLANNING UNITS

WRIA	Units	Forecast Population By Years 1970	1980	1985	1990	1995	2000	2020
55	LITTLE SPOKANE							
	Deer Park	1,295	1,559	1,622	1,687	1,754	1,824	2,134
	Rural	7,583	8,104	8,415	8,754	9,070	9,360	10,147
	Subtotal	8,878	9,663	10,037	10,441	10,824	11,184	12,281
56	HANGMAN CREEK							
	Cheney	6,358	7,313	7,844	8,412	9,022	9,676	12,802
	Fairfield	469	547	605	668	738	816	1,216
	Latah	169	148	138	129	121	113	86
	Rockford	327	367	367	367	367	367	367
	Spangle	179	200	200	200	200	200	200
	Waverly	48	61	61	61	61	61	61
	Tekoa	808	900	900	900	900	900	900
	Rural	4,232	4,660	4,880	5,121	5,357	5,614	6,295
	Subtotal	12,590	14,196	14,995	15,858	16,766	17,747	21,927
54	LOWER SPOKANE							
	Medical Lake	3,529	3,500	3,500	3,500	3,500	3,500	3,500
	Rural	4,153	4,292	4,374	4,489	4,595	4,700	4,998
	Subtotal	7,682	7,792	7,874	7,989	8,095	8,200	8,498
57	UPPER SPOKANE							
	Rural	3,681	4,473	4,833	5,218	5,627	6,016	7,327
	TOTAL NON-URBAN	32,831	36,124	37,739	39,506	41,312	43,147	50,033

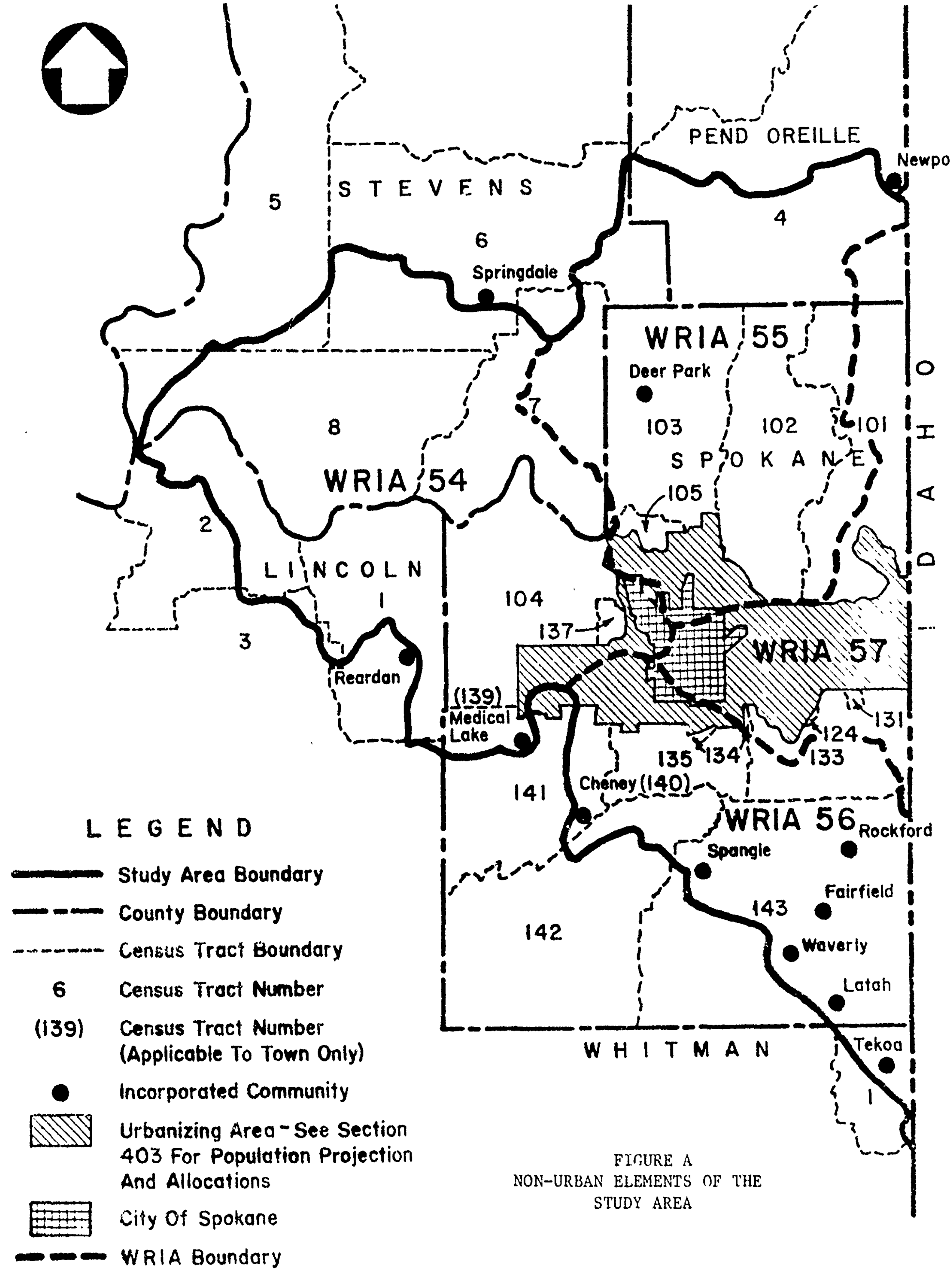

FIGURE A
NON-URBAN ELEMENTS OF THE
STUDY AREA

APPENDIX I
SMATS Zones Contained in
Each Planning Unit

City Sewered Area

-11*	241	444	632	842
-13	242	445	634	843
140	249(0%)	446	635	844
141	-33	447(0%)	636	845
142	340	448	645(100%)	846
143	341	530	-73	847
144	342	531	740(60%)***	850
145	343	532	741	851
146	344	533	742	852
147	345	534	743	864(0%)
152	-43	535	745(0%)	
154	440(100%)	536	752	
156	441	539	-83	
-23	442	630	840	
240(100%)**	443	631	841	

Moran Prairie

348	450	454
349	451	
447(100%)	452	
449	453	

Southwest

440(0%)	543
537	544
538	545
540	642
541	

West Plateau

531	645(0%)	654
633	650	655
640	651	-66
643	652	745(100%)
644	653	750

Orchard Prairie

151(0%)
163
164
170
250

North Spokane

NS-1	NS-2	NS-3	NS-4	NS-5	NS-6	NS-7	NS-8	NS-9
*** 740(40%)	856	157	148	162	171	870	872	167
864(100%)	857	160	149	166	867(10%)	871		172
869	862	161	150	168	868			173
	863	165	151(100%)					
		848	153					
		849	155					
		853	240(0%)					
		854						
		855						
		860						
		861						
		865						
		866						
		867(90%)						

Spokane Valley

SV-1	SV-2	SV-3		SV-4	SV-5
251	243	-4	64	352(100%)	71
260	245	50	65	353	371
	249(100%)	51	66	354	
	252	52	67	355	
	253	53	68	362	
	254	54	69	363	
	255	55	70	364	
	257	56	246	365(100%)	
	258	57	247	366(100%)	
	261	58	256		
	262	59	346		
		60	347		
		61	351		
		62	360		
		63	361		
			367		

Spokane Valley(Continued)

SV-6	SV-7	SV-8	SV-9	SV-10
265	277	274	264	263
273	372	276	270	266
	373	278	271	
	374		272	
	375		275	

Footnotes:

* SMATS zones with dash preceding number represents an entire SMATS district. Example: -23 represents SMATS zones 230, 231, 232, 233, 234, 235, 236, 237, 238, 239.

** Percentage figure represents percent of residential population of the corresponding SMATS zone living in the corresponding planning unit. Example: SMATS zone 440; while most of the land area lies in the City unit, some of it lies in the southwest unit. However, 100% of the residential population lives within the City portion of zone 440. These estimates were based on the housing distribution, as indicated in aerial photographs. The current population distribution was assumed to be constant to the year 2020.

*** Based on aerial photographs, 60% of zone 740's current population was assumed to be within the City planning unit, and 40% within the North Spokane unit. Since the City's portion is heavily built up, all future growth for zone 740 was assumed to occur in the North Spokane portion of that zone.

APPENDIX II
Population Forecast by
SMATS Zones

[illegible]	1970	1980	1985	1990	1995	2000	20[illegible]0
1	3115	3383	3341	3297	3254	321[illegible]	3144
4	917	1028	973	905	842	781	593
10	402	465	470	477	482	479	523
[illegible]	963	994	1060	11[illegible]	1161	1193	1390
[illegible]	1041	1322	1322	1322	1322	1322	1322
53	87	93	87	81	75	69	50
54	1264	1333	1343	1354	1350	1362	1443
~~55~~	1152	1352	1432	1516	1567	1620	1832
56	765	768	795	822	845	869	1068
57	818	1298	1298	1298	1298	1298	1298
58	10	10	7	4	1	0	0
59	1177	1227	1297	1370	1419	1468	1545
60	1135	1266	1329	1396	1502	1608	2063
61	1143	1254	1294	1336	1378	1420	1656
62	718	815	824	833	846	860	928
63	413	403	380	358	330	301	230
64	979	1033	1033	1033	1033	1033	1033
65	1100	1567	1618	1673	1743	1815	2157
66	981	1801	1803	1807	1835	1864	2064
67	966	1040	1049	1059	1081	1104	1256
68	1259	1410	1466	1526	1615	1706	1945
69	1085	1371	1443	1520	1662	1807	2399
70	1048	1161	1195	1230	1262	1295	1433
71	1384	1654	1713	1777	1835	1895	2231
[illegible]13	14217	14802	14755	14706	14742	14787	15200
[illegible]14	15694	17265	17429	17603	17789	17985	19058
150	305	311	276	239	202	165	48
151	401	456	473	491	506	522	599
152	125	135	139	142	146	151	156
153	551	561	572	585	602	619	690
154	61	307	318	331	347	364	428
155	755	784	816	848	891	935	1100
156	270	270	255	238	219	199	148
157	588	2179	2472	2781	3039	3301	4350
160	97	285	453	629	818	1008	1736
161	291	294	285	276	268	258	234
162	48	51	47	42	37	33	21
163	123	209	211	214	219	224	246
164	181	194	196	199	204	209	230
165	1042	1339	1437	1540	1624	1710	1915
166	42	39	35	31	31	31	31
167	453	829	842	854	876	899	993
168	79	1049	1074	1101	1140	1197	1385
170	10	22	22	2[illegible]	22	22	22
171	849	1709	2182	267[illegible]	[illegible]151	3626	5303
172	701	862	969	10[illegible]	1213	1317	1825
173	369	422	475	5[illegible]	597	664	900
[illegible]23	11461	13197	13197	1319[illegible]	13197	131[illegible]7	13197
~~[illegible]24~~	3325	5595	561[illegible]	56[illegible]	5687	57[illegible]	6096
200	172	220	245	27[illegible]	302	332	442
[illegible]	[illegible]097	1265	[illegible]	18[illegible]	2145	2397	3416
[illegible]	[illegible]022	1067	110[illegible]	1144	1154	1166	1230
[illegible]	[illegible]	1078	[illegible]	1230	1294	1357	1530
[illegible]	[illegible]	86[illegible]	[illegible]	89[illegible]	903	915	973
[illegible]	[illegible]	933	942	95[illegible]	971	982	10[illegible]
[illegible]	[illegible]	1441	[illegible]	1531	[illegible]	15[illegible]	[illegible]

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375	305	710	717	723	734	745	800
376	515	910	1016	1127	1238	1352	1899
377	86	89	95	101	111	122	159
378	159	162	311	468	630	792	1493
-33	6610	6566	6483	6396	6311	6231	6098
340	608	748	817	888	958	1029	1282
341	2228	2400	2522	2650	2777	2905	3385
342	2498	2781	2849	2922	2993	3066	3370
343	720	717	675	633	590	547	413
344	0	0	0	0	0	0	0
345	0	6	0	0	0	0	0
346	544	553	542	531	520	509	483
347	960	1000	1106	1218	1297	1378	1765
348	169	180	194	209	225	240	296
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361	934	1230	1265	1303	1350	1397	1587
362	1683	2158	2425	2630	2630	2630	2630
363	463	1689	1824	1966	2080	2080	2080
364	1879	2080	2177	2278	2352	2352	2352
365	264	954	1054	1160	1291	1424	1901
366	865	962	1748	2574	3765	4960	9267
367	1199	1757	1995	2246	2534	2824	4038
371	493	786	817	848	879	911	1036
372	563	811	852	894	932	972	1124
373	65	81	94	108	121	134	180
374	582	615	739	868	931	995	1286
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[illegible]	1586	1593	1599	1606	1612	1620	1681
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541	171	171	189	208	228	246	314
543	193	237	325	417	514	612	954
544	1757	1801	1927	2059	2191	2324	2929
545	83	90	100	110	122	135	179
551	362	392	407	434	468	503	659
[illegible]	4954	4952	4954	4956	4960	4966	5091
640	205	233	243	254	286	318	464
642	419	458	463	469	487	506	584
643	164	164	164	164	164	165	170
644	0	0	0	0	0	0	0
645	314	483	483	484	484	485	498
650	235	270	270	270	271	271	273
651	71	74	78	82	89	95	119
652	67	67	71	75	81	87	112
653	141	201	201	201	202	202	207
654	208	237	290	359	419	479	761
655	677	677	785	897	1027	1156	1692
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851	658	983	999	1017	1033	1050	1131
852	2538	2589	2643	2710	2770	2792	2792
853	890	956	966	976	986	997	1055
854	413	440	440	441	441	442	454
855	770	793	807	820	835	850	918
[illegible]	6	53	278	514	789	1065	2020
[illegible]	68	80	224	376	551	729	1340
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1	1987	2121	[illegible]	2146	2579	2713	3356
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[illegible]	[illegible]	861		886	917	946	1088
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[illegible]	[illegible]	210	[illegible]	4088	[illegible]	5993	6571
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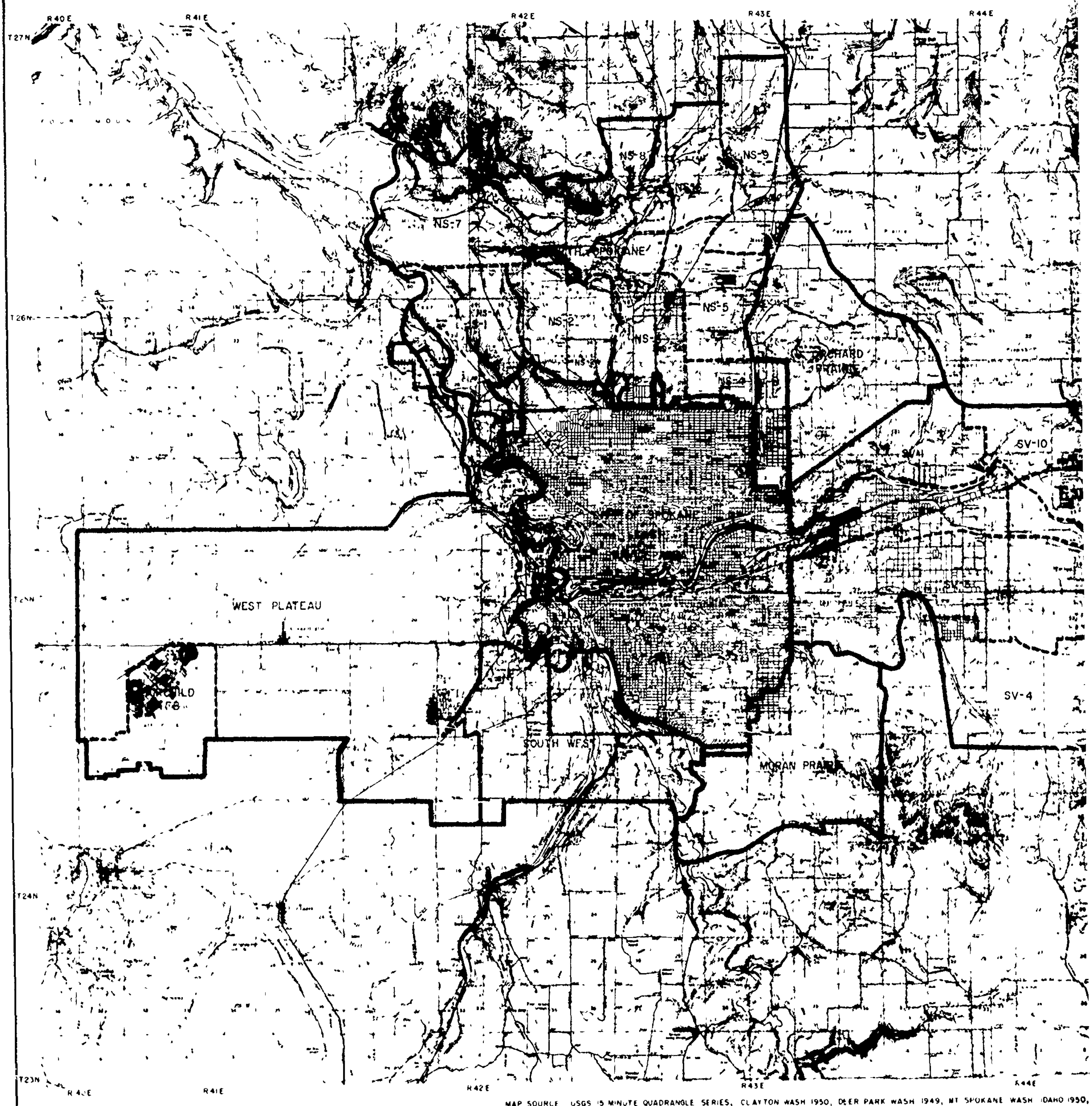


MAP SOURCE USGS 15 MINUTE QUADRANGLE SERIES, CLAYTON WASH 1950, DEER PARK WASH 1949, MT SPOKANE WASH IDAHO 1950, MEDICAL LAKE WASH 1954, SPOKANE WASH 1950, GREENACRES WASH-IDAHO 1949

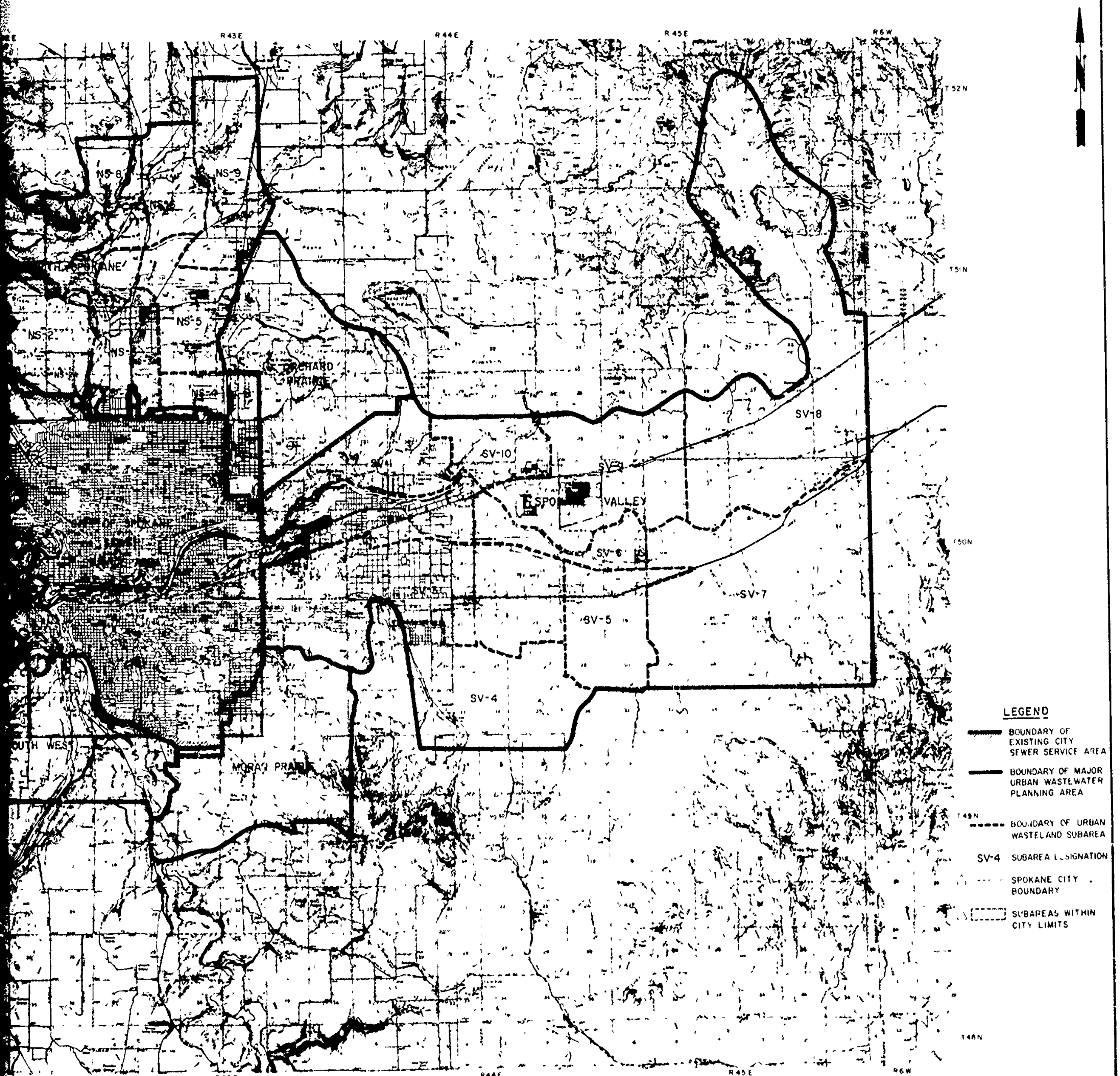
MILES

FEET

GRAPHIC SCALES

REVISIONS

SYMBOL	DESCRIPTION	DATE	BY
△	Adds City boundary and subareas within City	4 Dec 74	B.P.



SOURCE USGS 15 MINUTE QUADRANGLE SERIES, CLAYTON WASH 1950, DEER PARK WASH 1949, MT SPOKANE WASH IDAHO 1950 MEDICAL LAKE WASH 1954 SPOKANE WASH 1950, GREENACRES WASH-IDAHO 1949

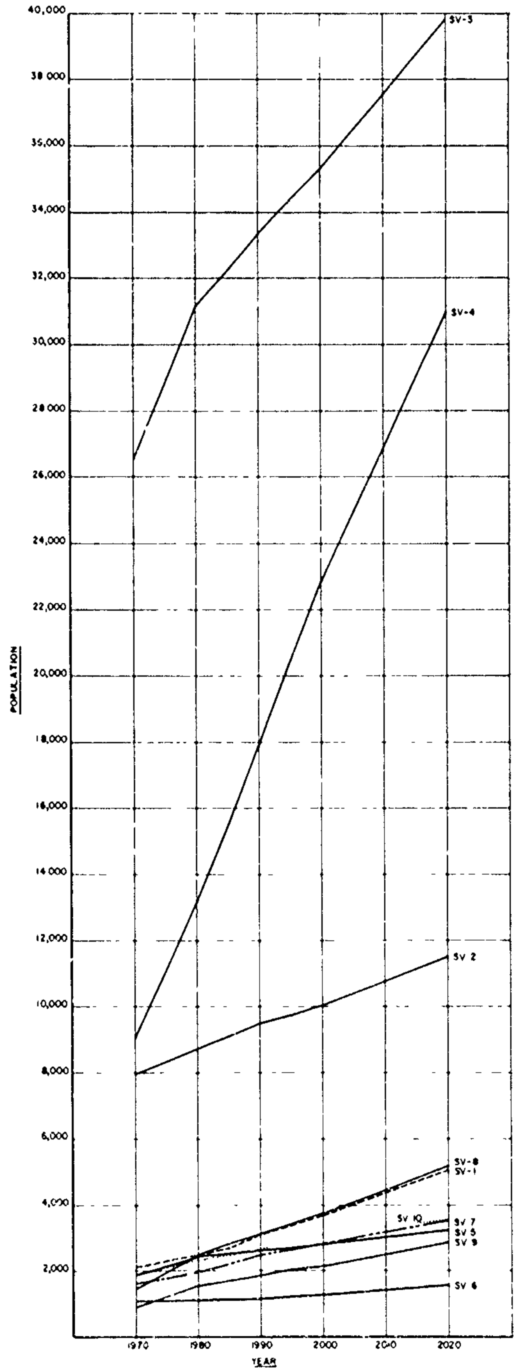
KENNEDY TUDOR CONSULTING ENGINEERS SEATTLE WASHINGTON	U S ARMY ENGINEER DISTRICT SEATTLE CORPS OF ENGINEERS SEATTLE WASHINGTON

WATER RESOURCES STUDY
METROPOLITAN SPOKANE REGION

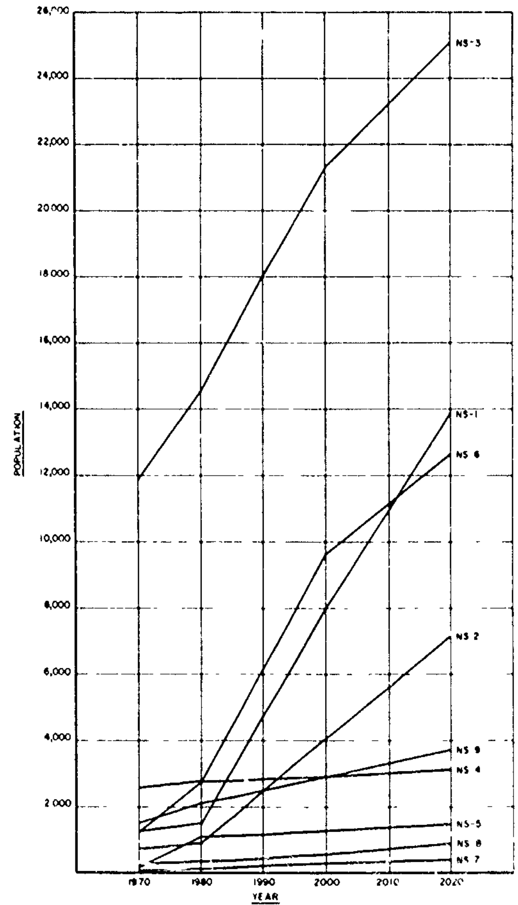
PLANNING UNITS
URBAN PLANNING AREA

DACW67-73-C-0096

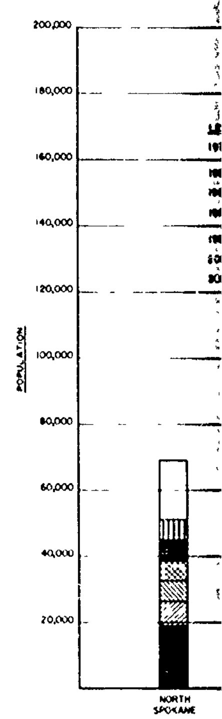
602-1



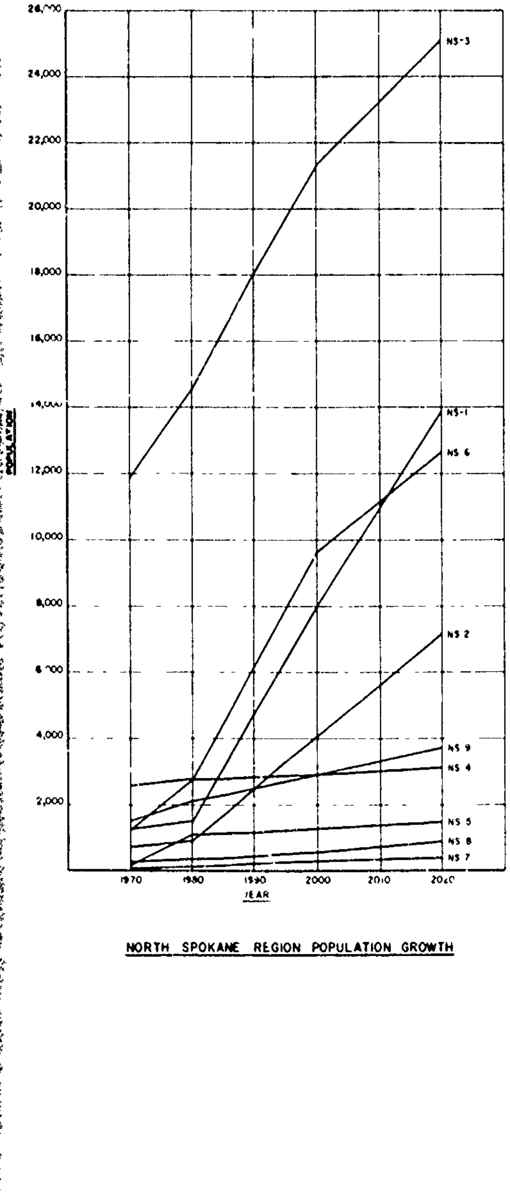
SPOKANE VALLEY REGION POPULATION GROWTH



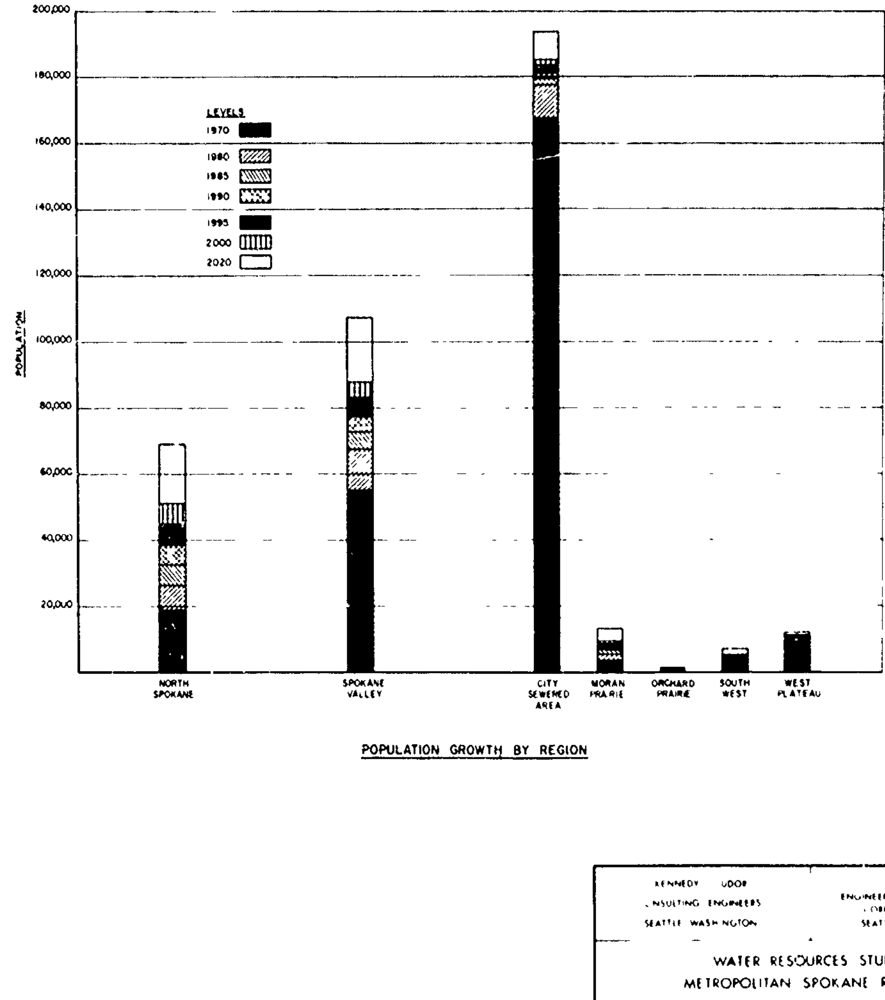
NORTH SPOKANE REGION POPULATION GROWTH



REVISIONS			
	DESCRIPTION	DATE	BY



NORTH SPOKANE REGION POPULATION GROWTH



POPULATION GROWTH BY REGION

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CONSULTING ENGINEERS
SEATTLE WASHINGTON

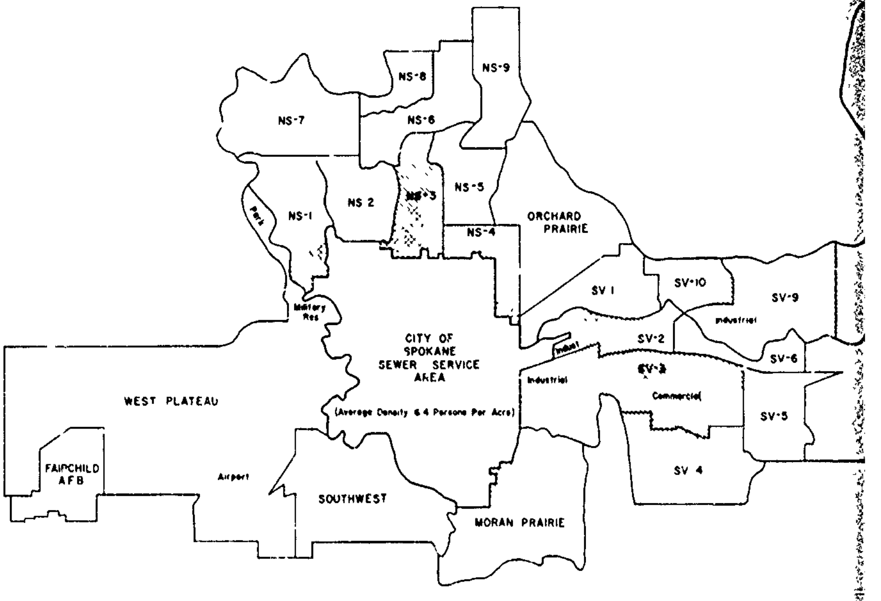
U. S. ARMY
ENGINEER DISTRICT SEATTLE
CORPS OF ENGINEERS
SEATTLE WASHINGTON

WATER RESOURCES STUDY
METROPOLITAN SPOKANE REGION

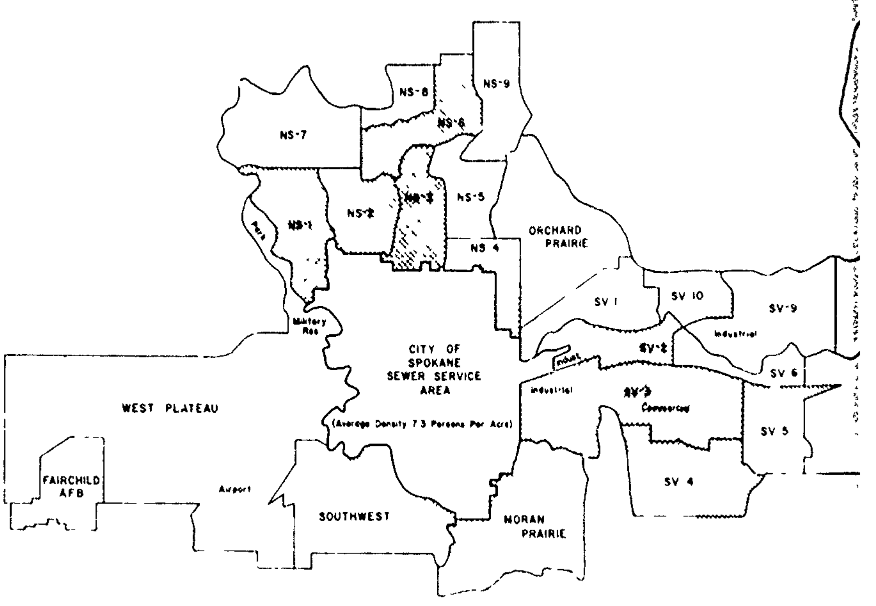
POPULATION FORECASTS
OF
PLANNING UNITS
URBAN PLANNING AREA

DACW67 71 0096

PLATE 602-2

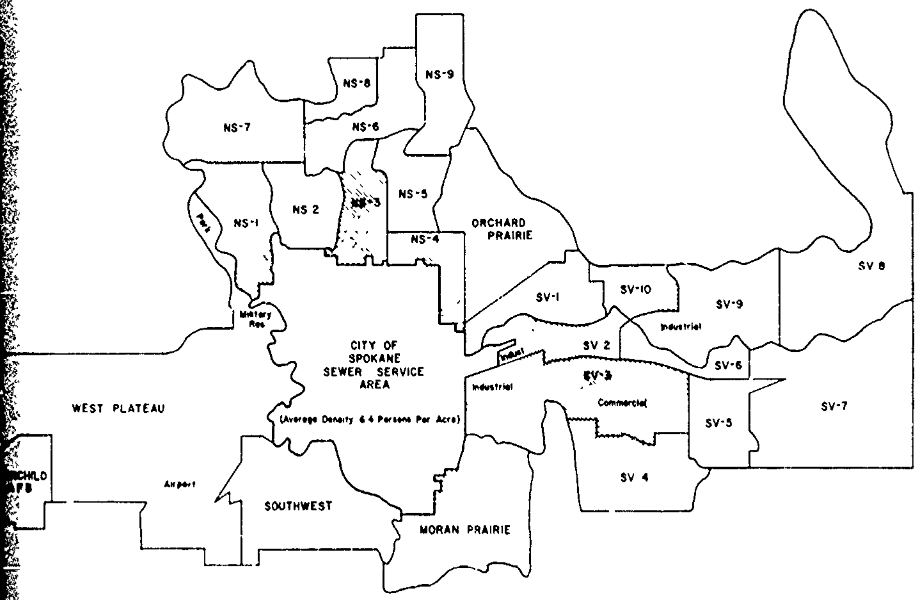


EXISTING DENSITIES IN 1970

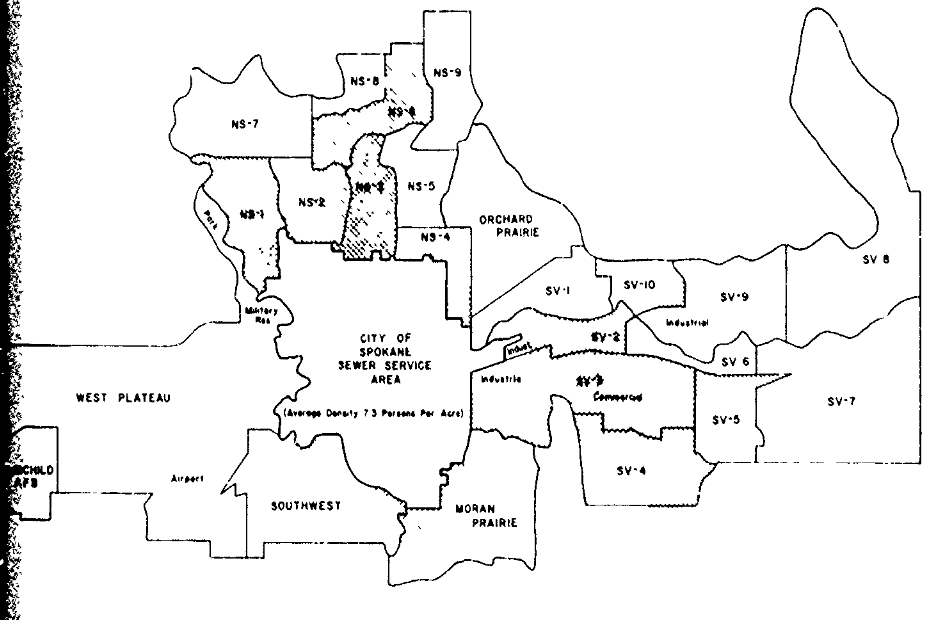


FORECAST DENSITIES AT YEAR 2020

REVISIONS			
	DESCRIPTION	DATE	BY



EXISTING DENSITIES IN 1970



FORECAST DENSITIES AT YEAR 2020

LEGEND

- LESS THAN 2 PERSONS PER ACRE *
- 2 TO 5 PERSONS PER ACRE *
- OVER 5 PERSONS PER ACRE *

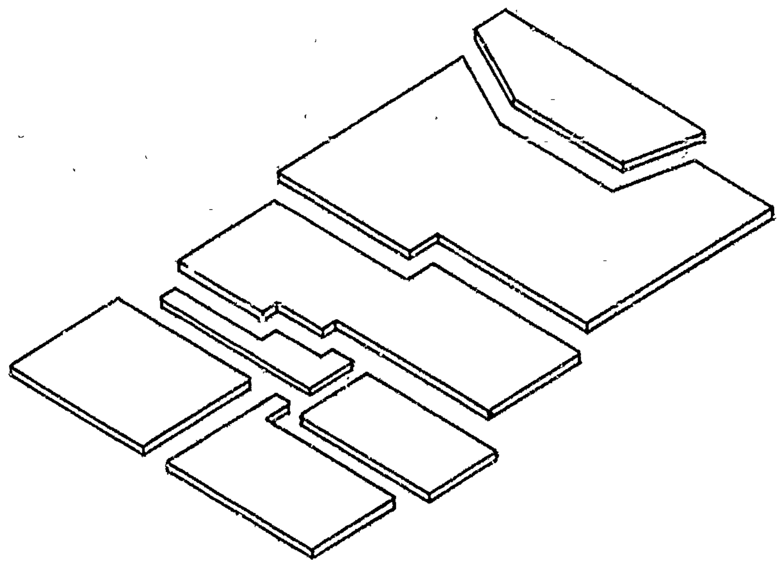
* Based On Gross Area Of SMATS Zone

U.S. ARMY

WATER RESOURCES STUDY
METROPOLITAN SPOKANE REGION

POPULATION DENSITIES
RELATED TO
PLANNING UNITS

602-3



SECTION 604.3

ELEMENTS OF ALTERNATIVE PLANS FOR WASTEWATER MANAGEMENT

WATER RESOURCES STUDY

METROPOLITAN SPOKANE REGION

SECTION 604.3

ELEMENTS OF ALTERNATIVE PLANS

FOR WASTEWATER MANAGEMENT

10 October 1975

Department of the Army, Seattle District
Corps of Engineers
Kennedy-Tudor Consulting Engineers

INDEX

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Mapping	604.3-1
Special Explanations	604.3-3
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E	" (C+NS)-1p	604.3- 9
F	" (C+NS)-1i	604.3-10
G	" (C+SV)-sw	604.3-11
H	" (C+SV)-1p	604.3-12
I	" (C+SV)-1i	604.3-13
J	" (C+NS+SV)-sw	604.3-14
K	" (C+NS+SV)-1p	604.3-15
L	" (C+NS+SV)-1i	604.3-16
M	" NS-sw	604.3-17
N	" NS-1p	604.3-18
O	" NS-1i	604.3-19
P	" SV-sw	604.3-20
Q	" SV-1p	604.3-21
R	" SV-1i	604.3-22
S	" (NS+SV)-sw	604.3-23
T	" (NS+SV)-1p	604.3-24
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W	" (C+NS)-1i-sw	604.3-27
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SECTION 604.3
ELEMENTS OF ALTERNATIVE PLANS
FOR WASTEWATER MANAGEMENT

Scope and Objectives

The objective of this section is to present scale maps of elements of alternative plans for wastewater management previously developed in narrative form in Section 604.2. These maps delineate the location of treatment facilities and conveyance structures for twenty-one site specific plans corresponding to the possible permutations of three basic service areas with three basic disposal alternatives. In addition, three subalternatives elements are included for seasonal irrigation for city-involved service area combinations, making a total of twenty-four plan elements.

The purpose of these maps is to form the basis for development of capital and operation costs for each element to be used in cost effectiveness analysis.

Mapping

The maps included herein as Figures B through Y are developed as overlays on U.S.G.S. mapping at 1:62,500 or 1 inch equal one mile. Figures C, F, H, I, K and L are reduced to half size for convenience in reproduction herein. The basic points of coordination with the U.S.G.S. mapping are the points of concentration for each of the three service areas as follows:

(1) C - City at the existing City of Spokane STP site.

(2) NS - North Spokane at a site adjacent to the Fish Hatchery.

(3) SV - Spokane Valley at a site on or adjacent to the eastern end of Felts Field.

Areas shown for land disposal by infiltration-percolation are defined as follows: The site area is the total land area which will be required at 2020. The gross area is that part of the site needed for the year 2000 construction and the net area is the actual working surface at year 2000. The entire site needs for year 2020 are assumed acquired in 1980. The percolation pond construction is by stages to year 2000 needs.

For land irrigation alternatives the areas shown include the last incremental acquisition in 1995 for year 2000 needs. Incremental acquisition from 1980 is staged to suit forecast needs in 5 year increments. Gross area includes areas for internal access roads and peripheral buffer zones and is equivalent to site needs. The net area is the areas of actual cultivation for which the last incremental distribution construction would take place in 1995 for year 2000 needs. In the case of the storage reservoir for irrigation, the site is assumed acquired in 1980 for year 2020 needs. The gross and net storage volumes correspond to year 2000 needs. Where lagoon treatment is used as pretreatment for irrigation, the site is acquired in 1980 for year 2020 forecast needs and net areas are shown for staged construction to last increment for year 2000 forecast needs.

The committed upgrading and expansion of the City STP to 40 mgd capacity with secondary treatment is shown as "existing" on the

mapping as of 1980. Where addition to the 40 mgd capacity is required, the gross capacity after addition is shown with the date of construction of the addition. Other treatment facilities are shown with staged construction, where applicable, to forecast year 2000 capacity, again in terms of total capacity resulting from eacl 'ncrement.

Conveyance structures are sized for year 2020 requirements and construction is a single stage at 1980 unless otherwise noted. Refinements such as parallel lines for added security or velocity control are not considered at this stage of development. Only static pumping heads are shown. Cost calculations considered dynamic heads as well, computed for the forecast flows as they develop.

Refer to criteria for cost effective analysis for other sizing and siting considerations.

Locations and routes are selected for physical feasibility and lower range costs and are site-specific to the extent that the layouts represent feasible plans for which costs can be developed. To the extent that design stage refinement would reexamine alternative alignments and exact locations, the plans may be regarded as schematic.

Special Explanations

1. A plate is not shown for the following elements listed in Table 1 of Section 701.1 for the reasons indicated below.

Element	Remarks
C - sw	Consists only of an indication of the location of the City STP. No facilities outside the existing site are involved.
C - sw/lp	Equal to C - sw to 1990 C-lp after 1990
(C+N) - sw/lp	Equal to (C+N)-sw to 1990 (C+N)-lp after 1990

Element	Remarks
(C+SV) - sw/lp	Equal to (C+SV) - sw to 1990 (C+SV)-lp after 1990
NS - sw/lp	Equal to NS-sw to 1990 NS-lp after 1990
NS - sw/li	Equal to NS-sw to 1990 NS-li after 1990
SV - sw/lp	Equal to SV-sw to 1990 SV-sw after 1990
SV - sw/li	Equal to SV-sw to 1990 SV-li after 1990

2. The following elements identified by "-li-sw" are special subalternatives which involve two disposal methods operated in alternate seasons, land application (li) in summer and surface water disposal (sw) in winter. (They are to be distinguished from elements identified by sw/li which represent a change from year around surface water disposal to 1990 to year around land application after 1990):

C - li - sw

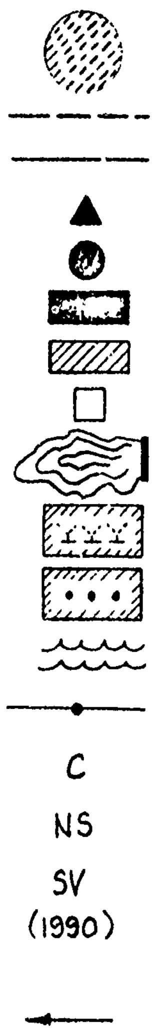
(C+NS) - li - sw

(C+SV) - li - sw

(C + NS + SV) - li - sw

LEGEND

(Applies to Figures B through Y)



	Natural Point of Concentration
	Service Area Conveyance
	Disposal Conveyance
	Pump Station
	Equalizing Storage
	Treatment Facility, Other Than Lagoon
	Treatment Facility, Lagoon
	Chlorination, Where Separate From Treatment
	Dam and Reservoir
	Land Application, Irrigation
	Land Application. Percolation
	Surface Water Disposal
	Change in Size or Pipe Class
C	City Service Area
NS	North Spokane Service Area
SV	Spokane Valley Service Area
(1990)	Indicates Date of Construction or Aquisition, Other than 1980
	Direction of Flow
ES	Equalizing Storage
FM	Force Main
GS	Gravity Sewer
MG & MGD	Million Gallons and Million Gallons per Day
PS	Pump Station

FIGURE A
LEGEND

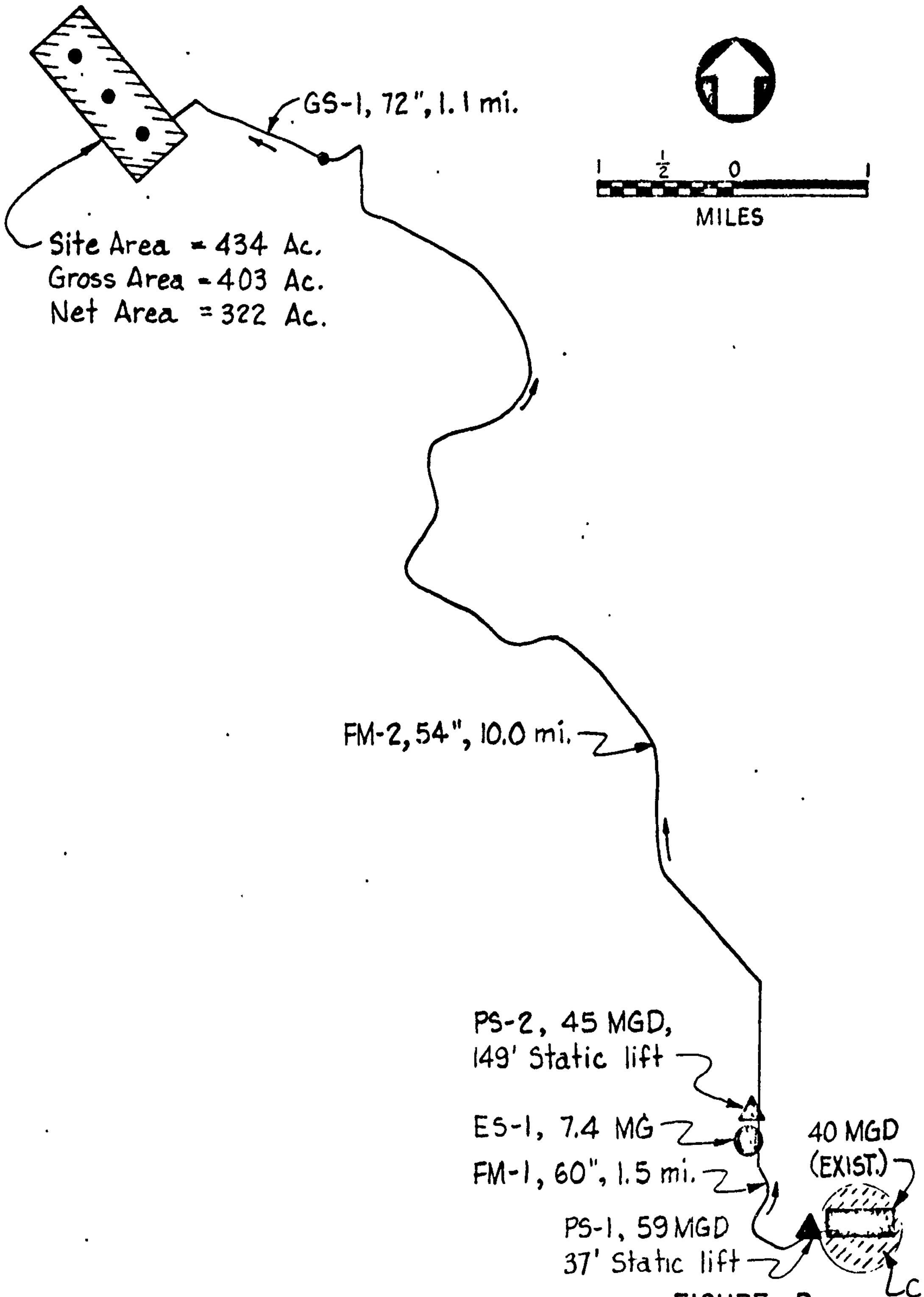


FIGURE B
ELEMENT C-1p

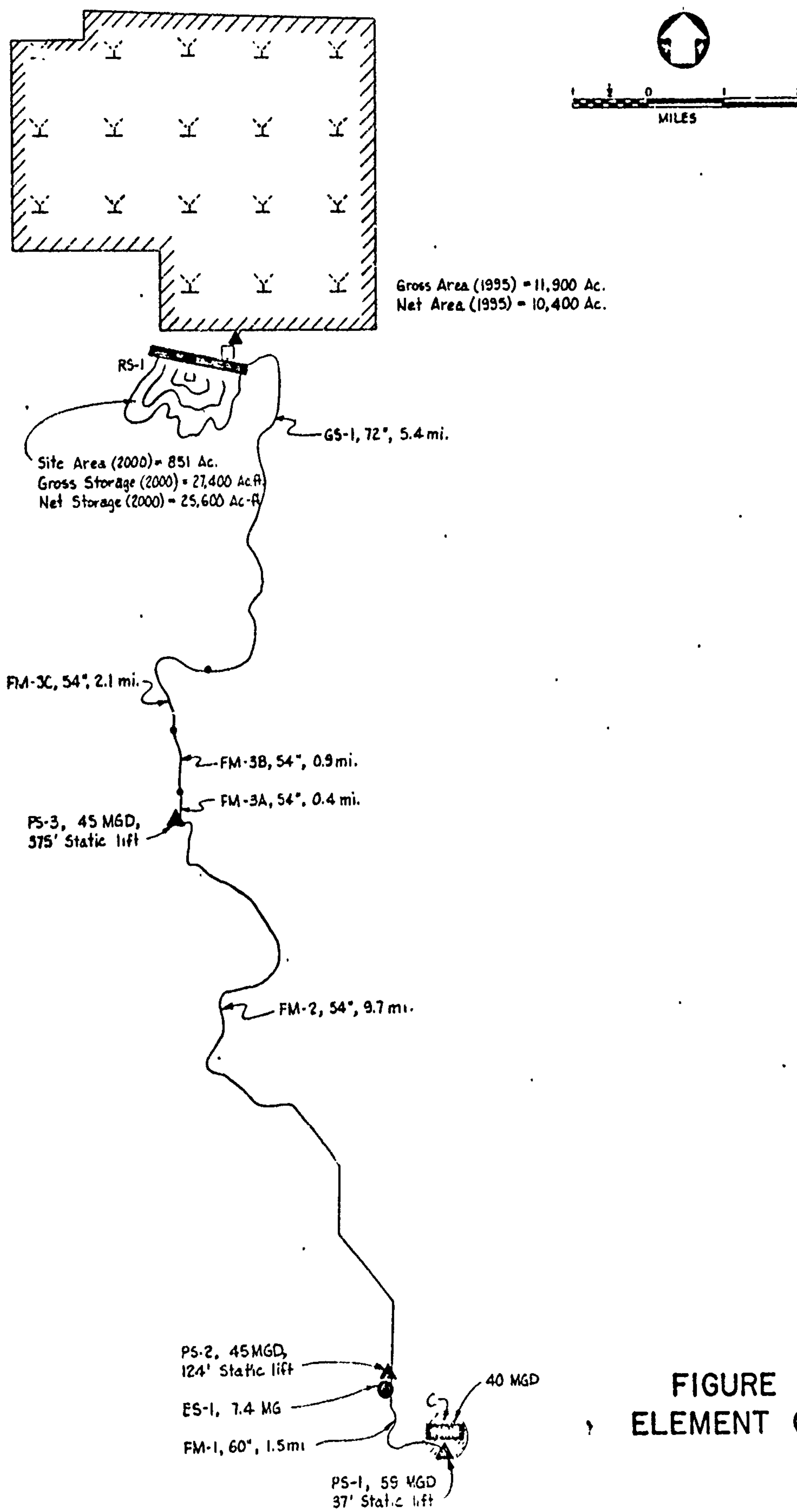


FIGURE C
ELEMENT C-li

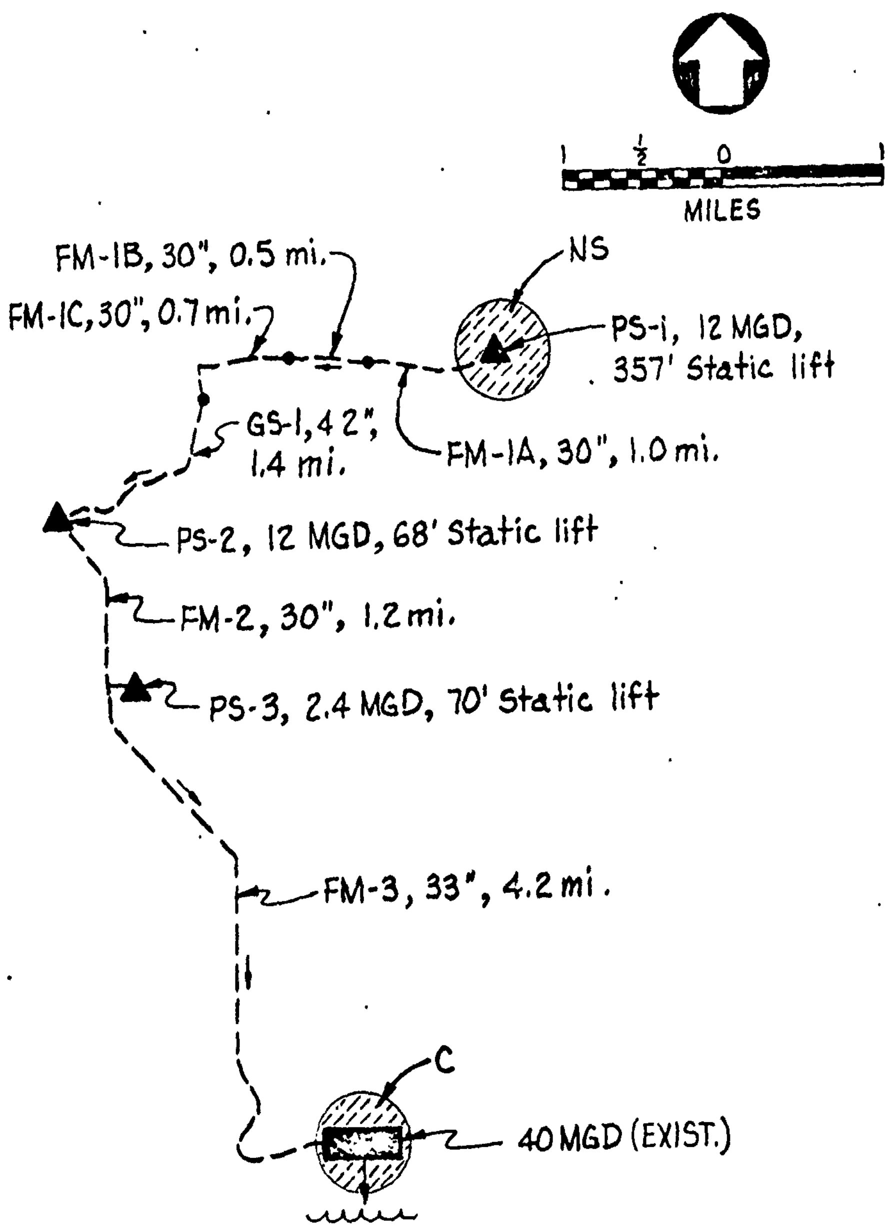


FIGURE D
ELEMENT (C+NS)-sw

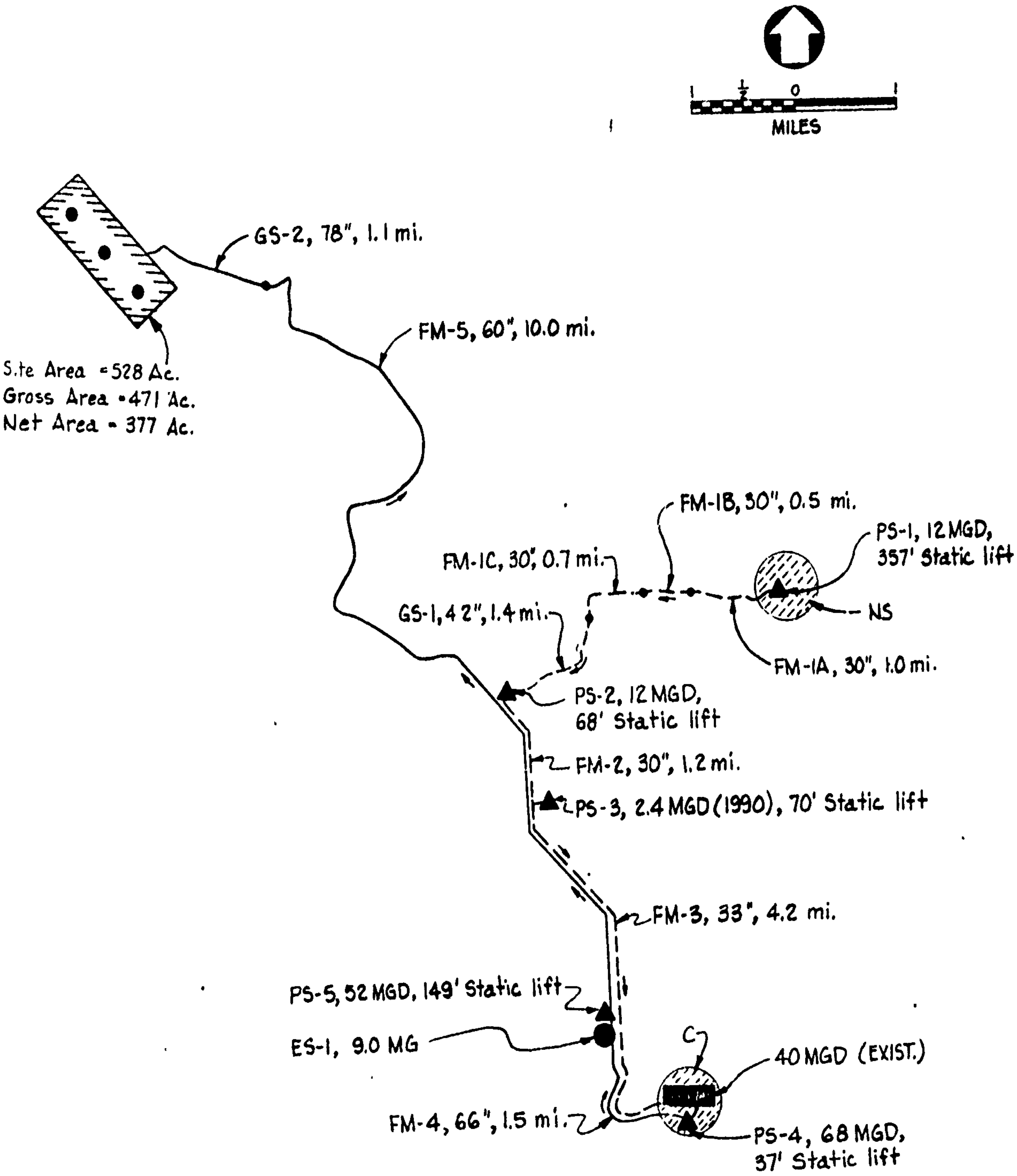


FIGURE E
ELEMENT (C+NS)-1p

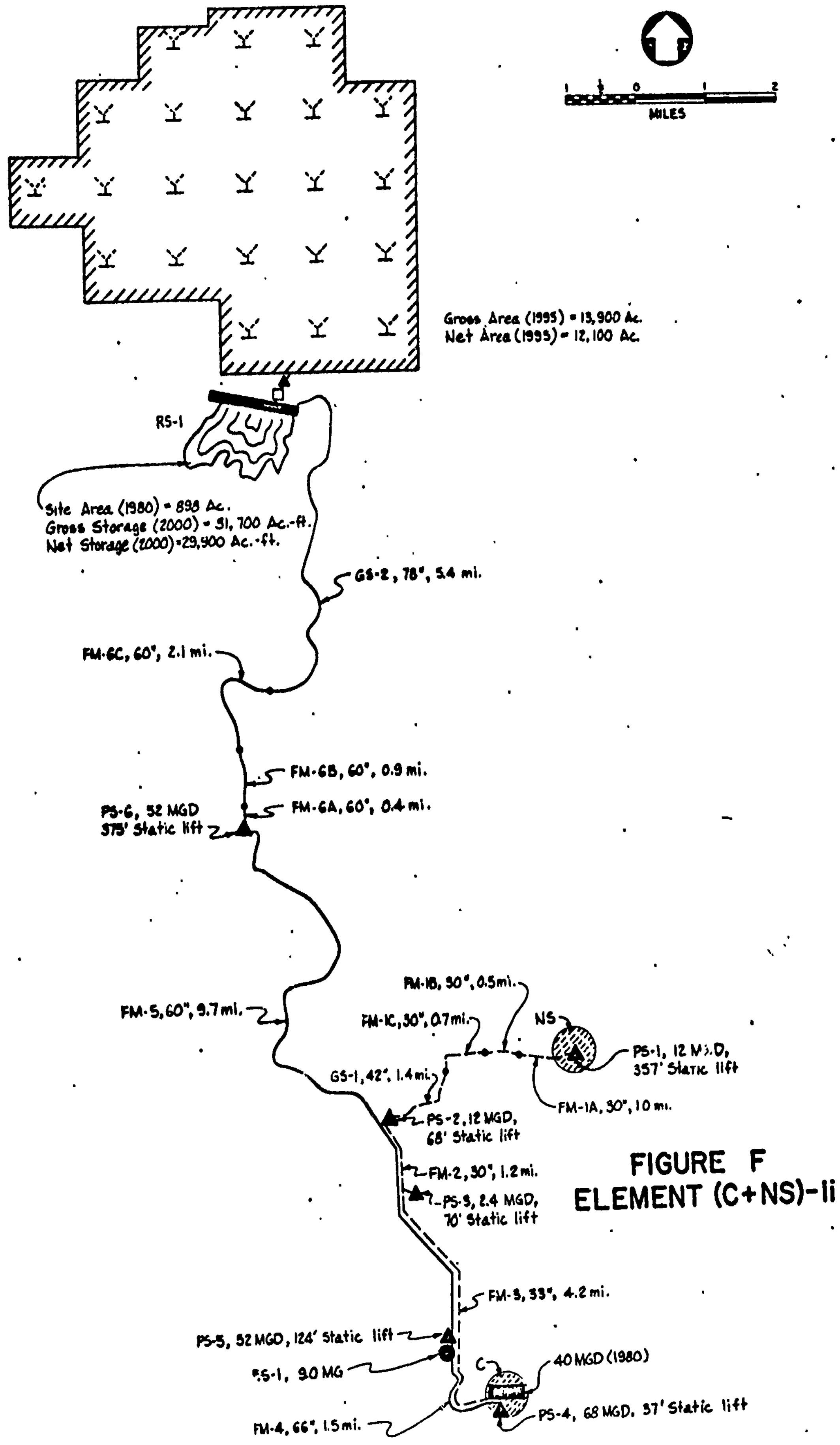


FIGURE F
ELEMENT (C+NS)-Ii

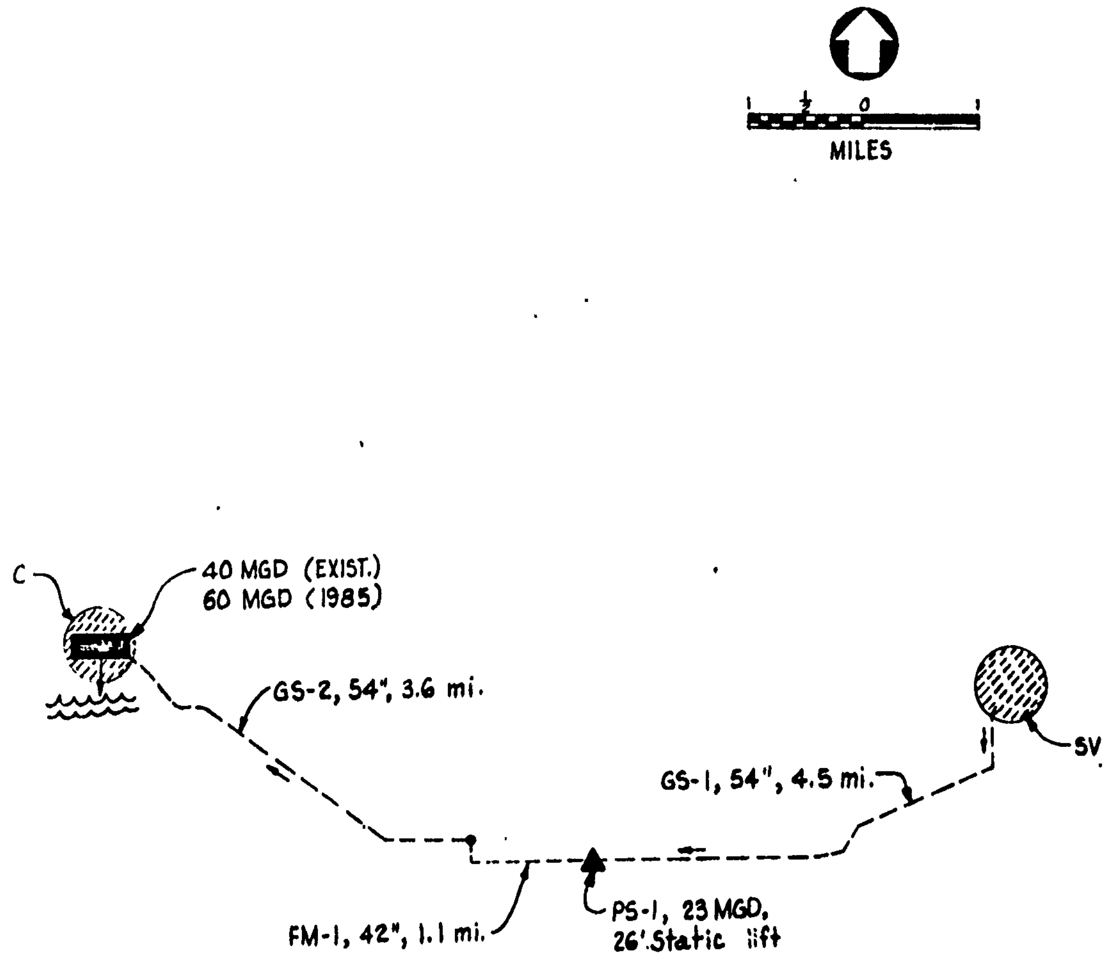


FIGURE G
ELEMENT (C+SV)-sw

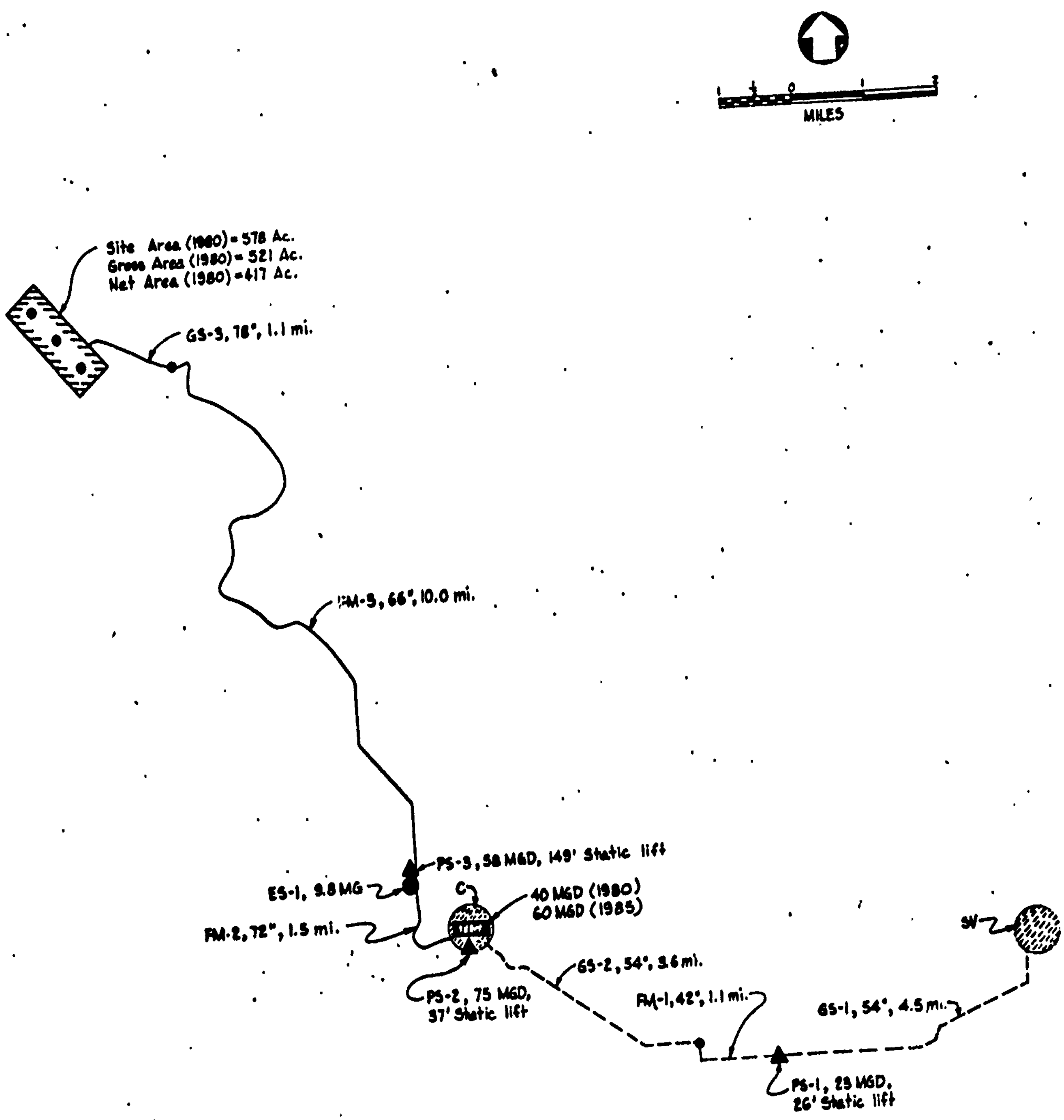


FIGURE H
ELEMENT (C+SV)-1p

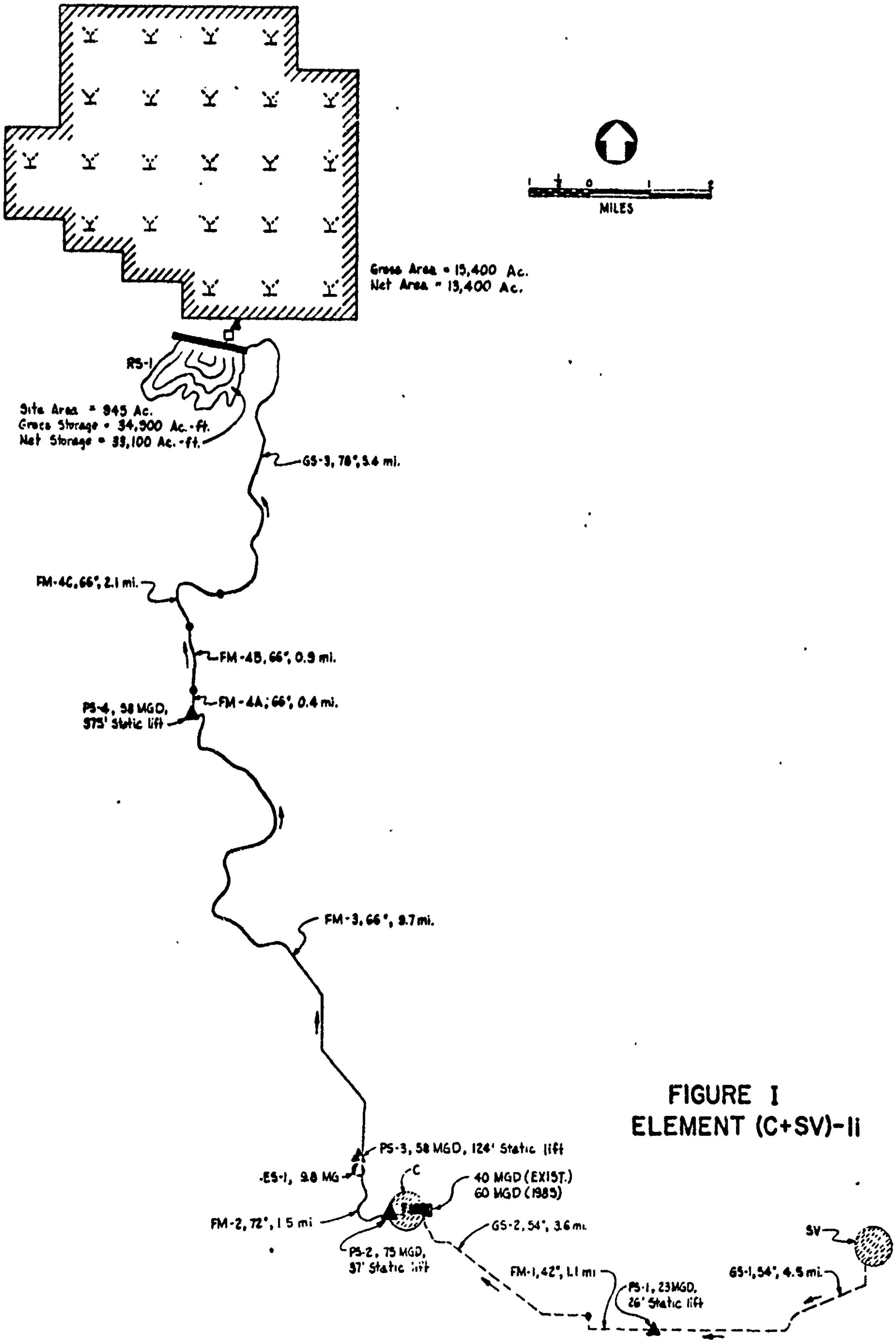


FIGURE I
ELEMENT (C+SV)-II

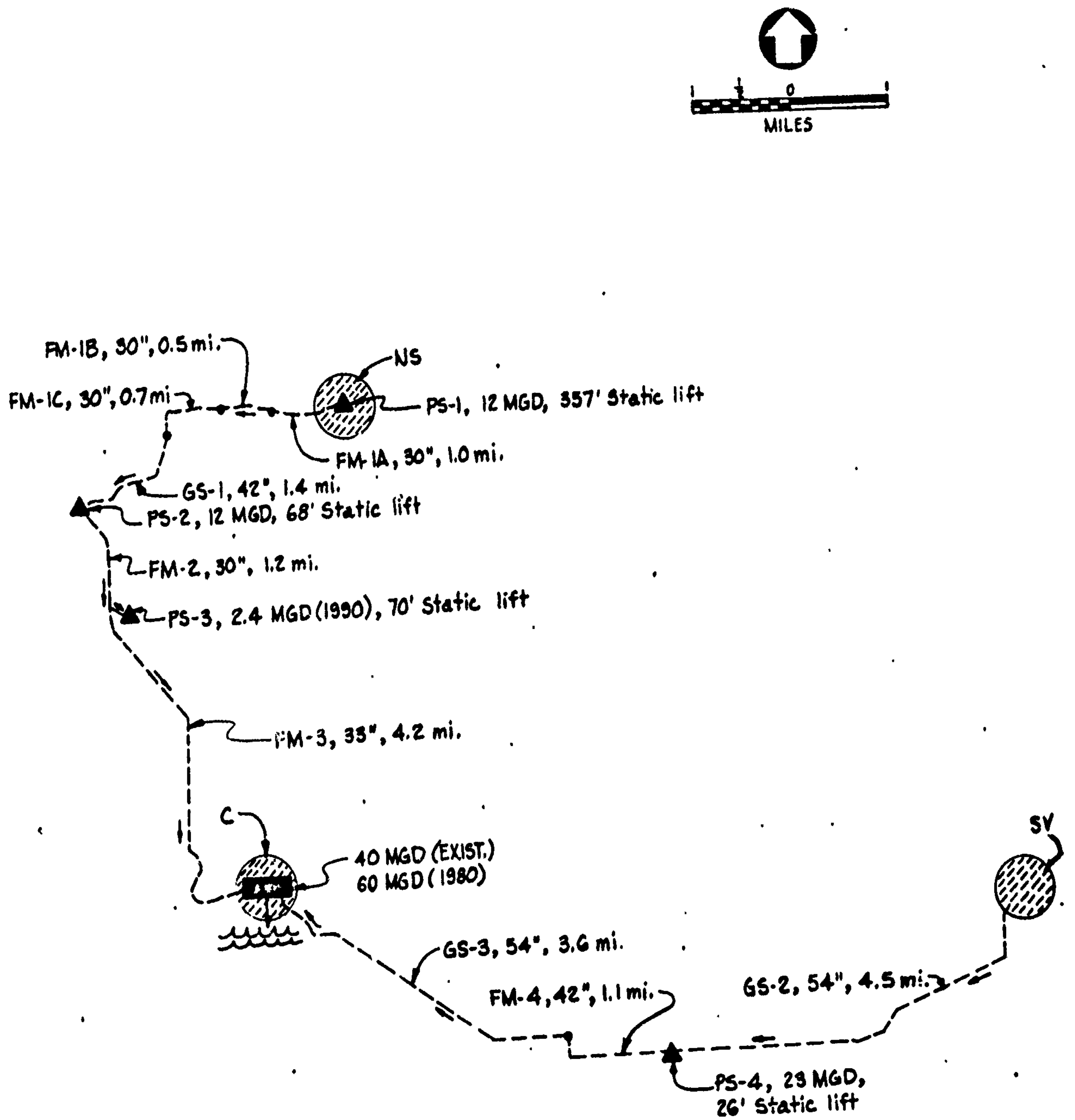


FIGURE J
ELEMENT (C+NS+SV)-sw

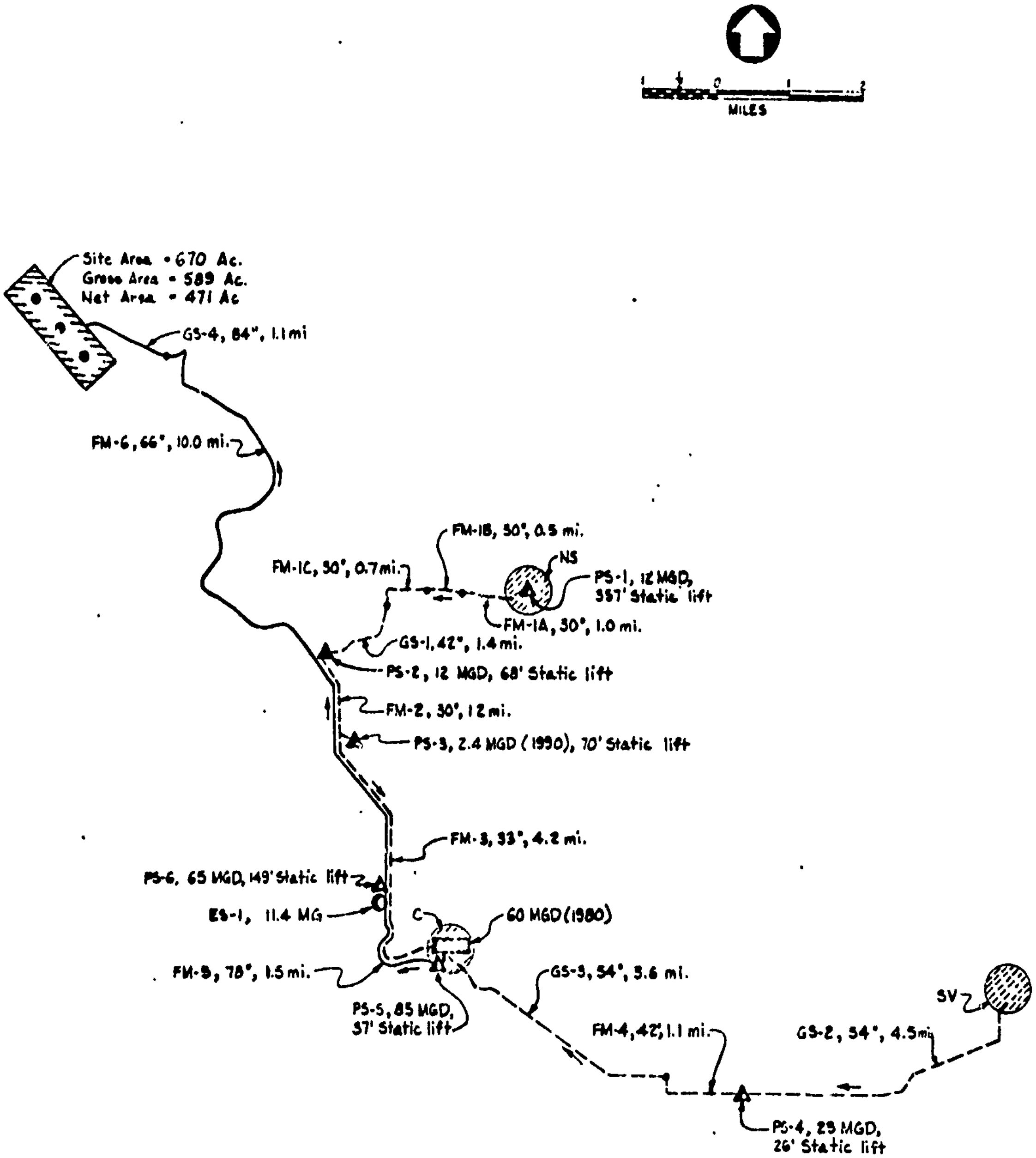


FIGURE K
ELEMENT (C+NS+SV)-Ip

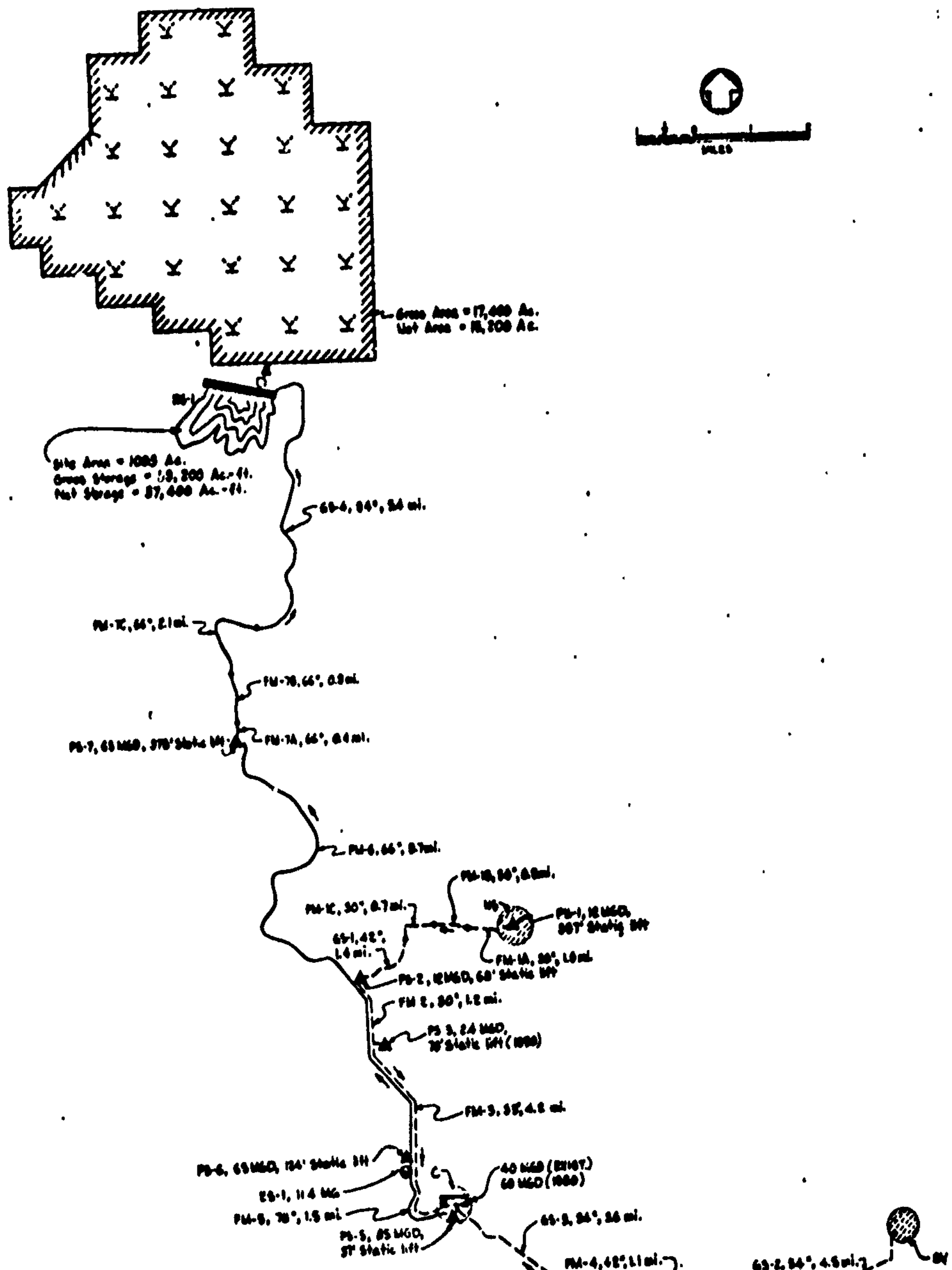


FIGURE L
ELEMENT (C+NS+SV)-II

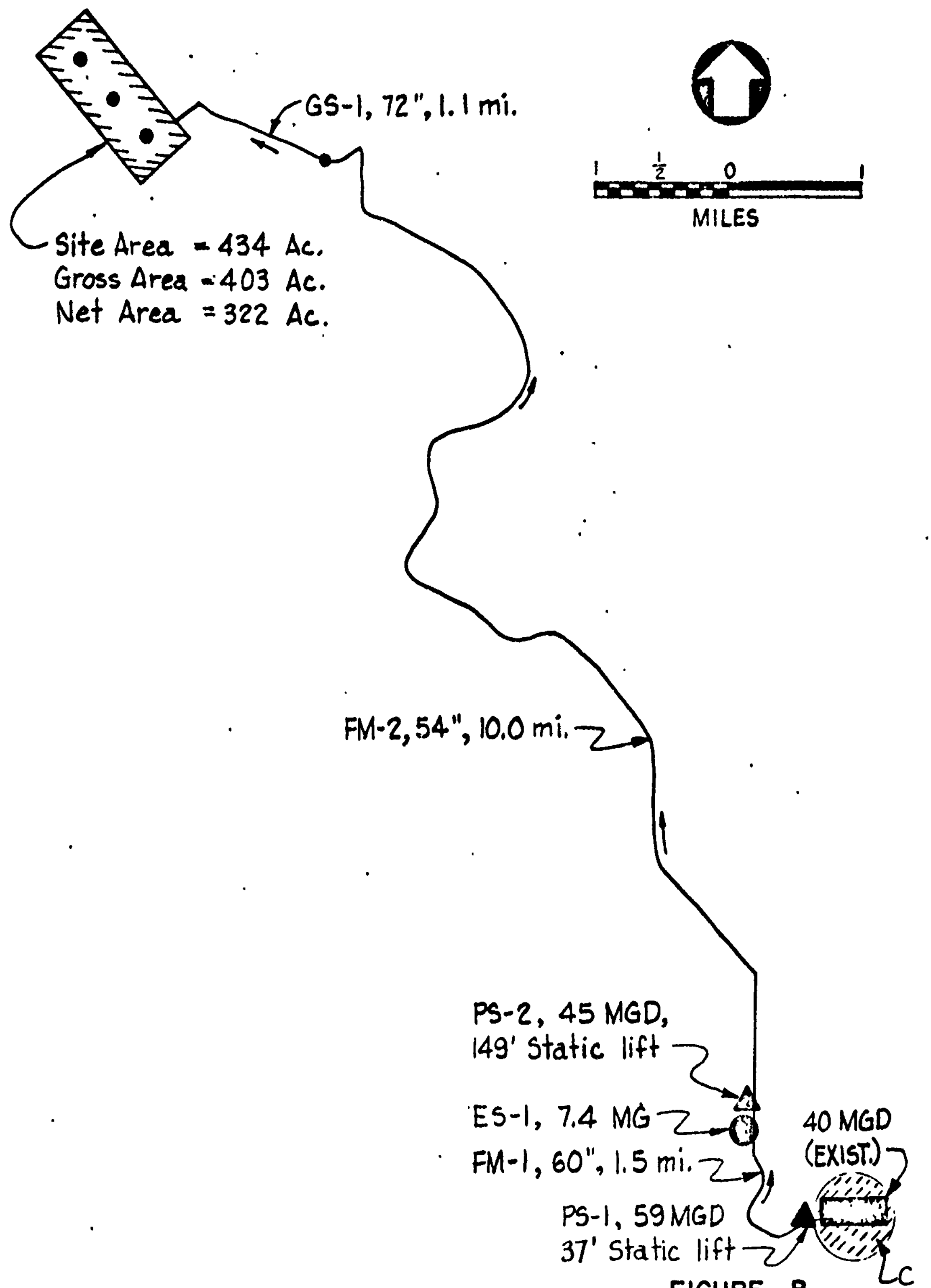


FIGURE B
ELEMENT C-1p

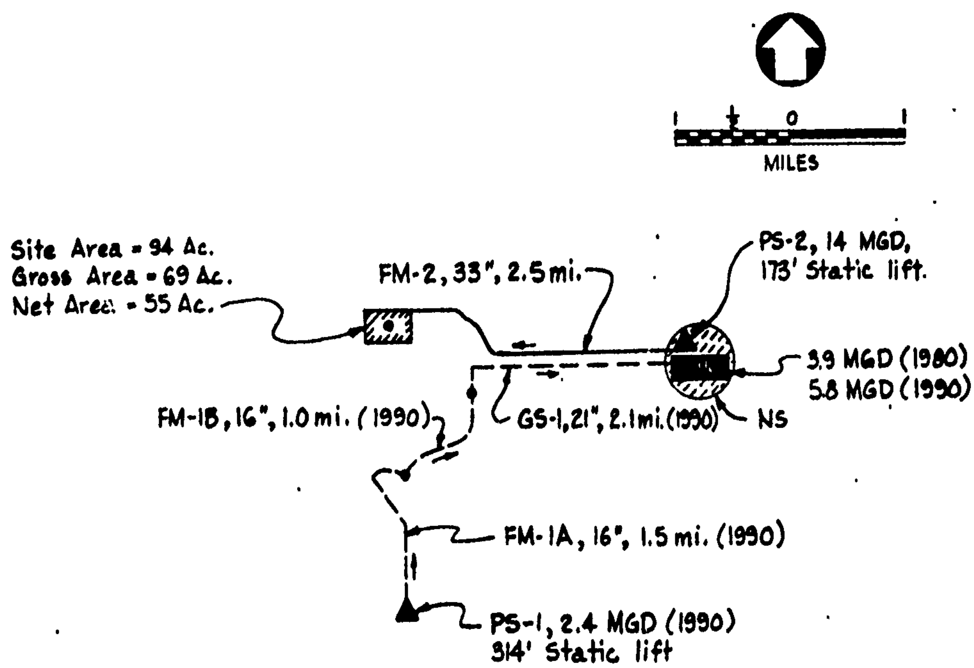


FIGURE N
ELEMENT NS-1p

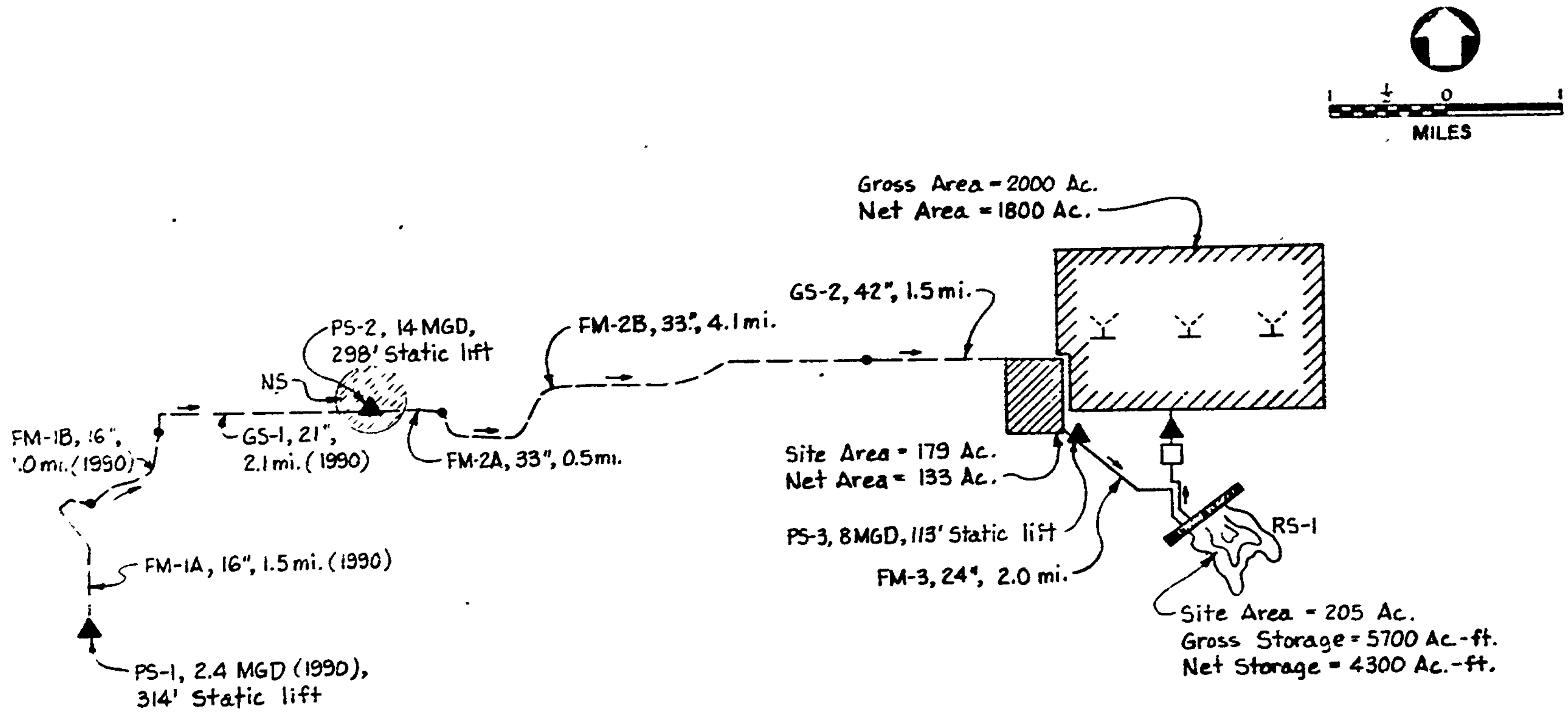


FIGURE O
ELEMENT NS-ii

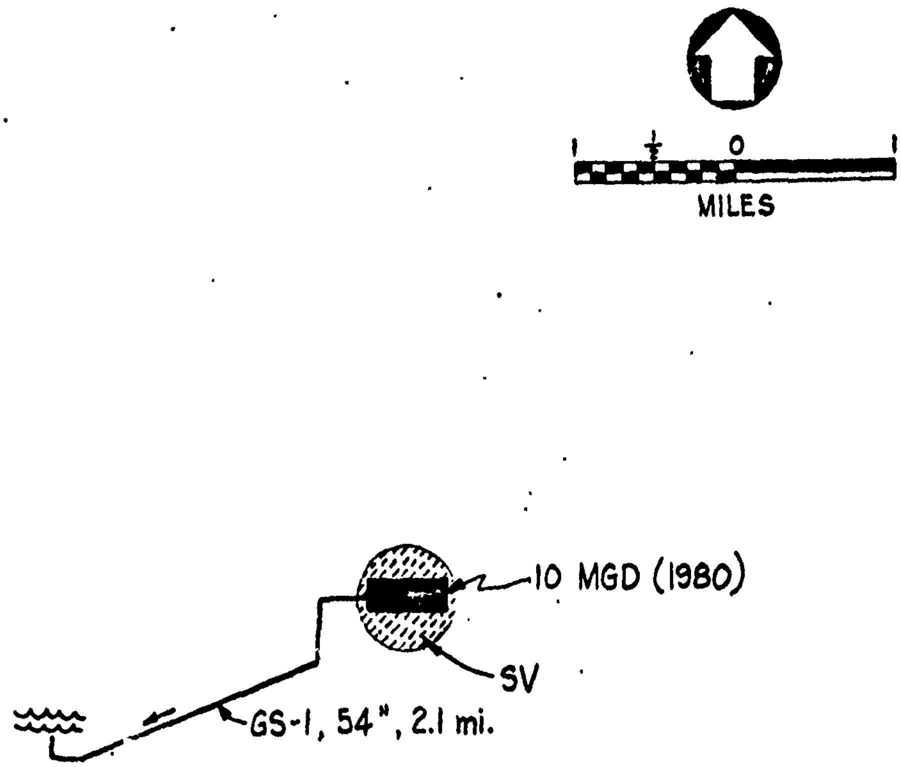


FIGURE P
ELEMENT SV-sw

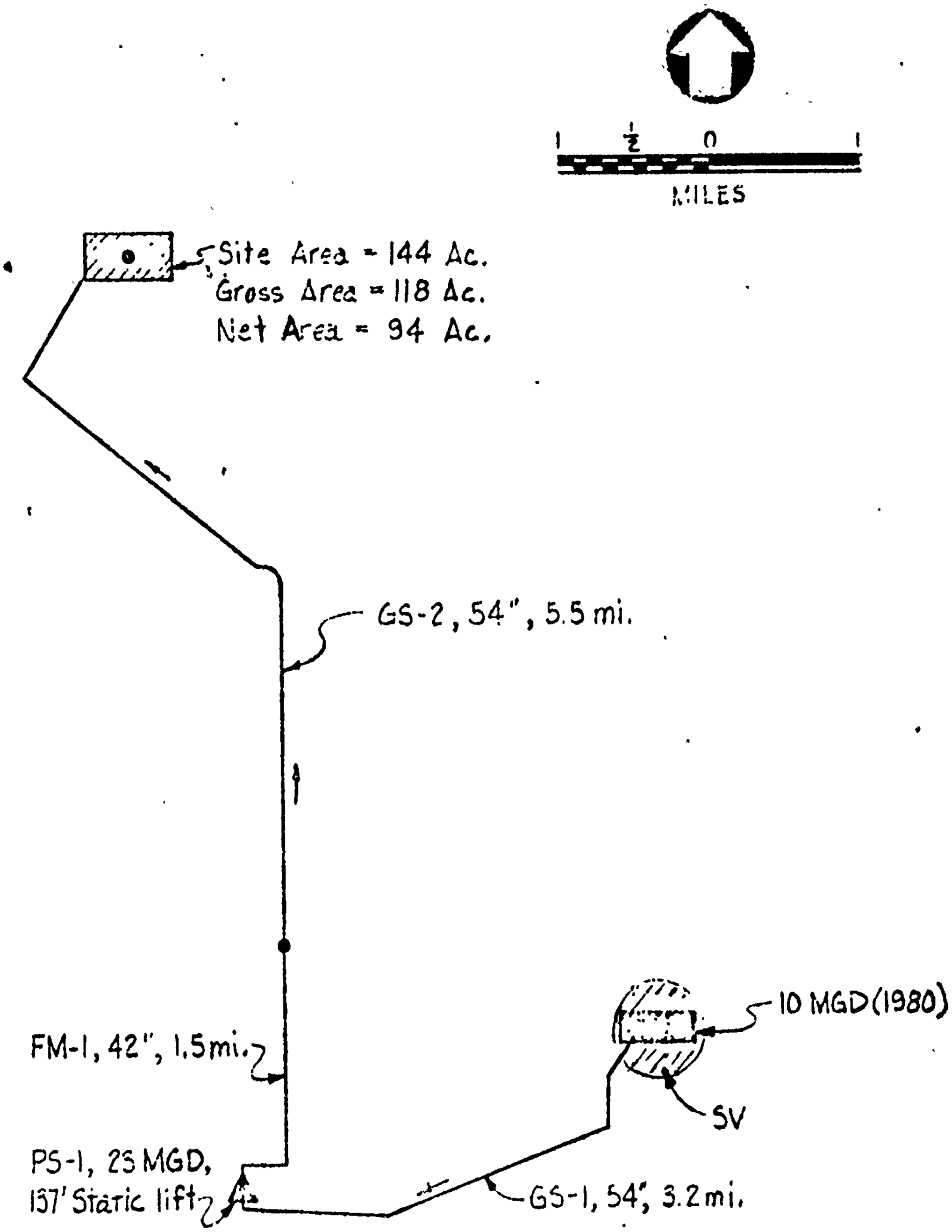


FIGURE Q
ELEMENT SV-Ip

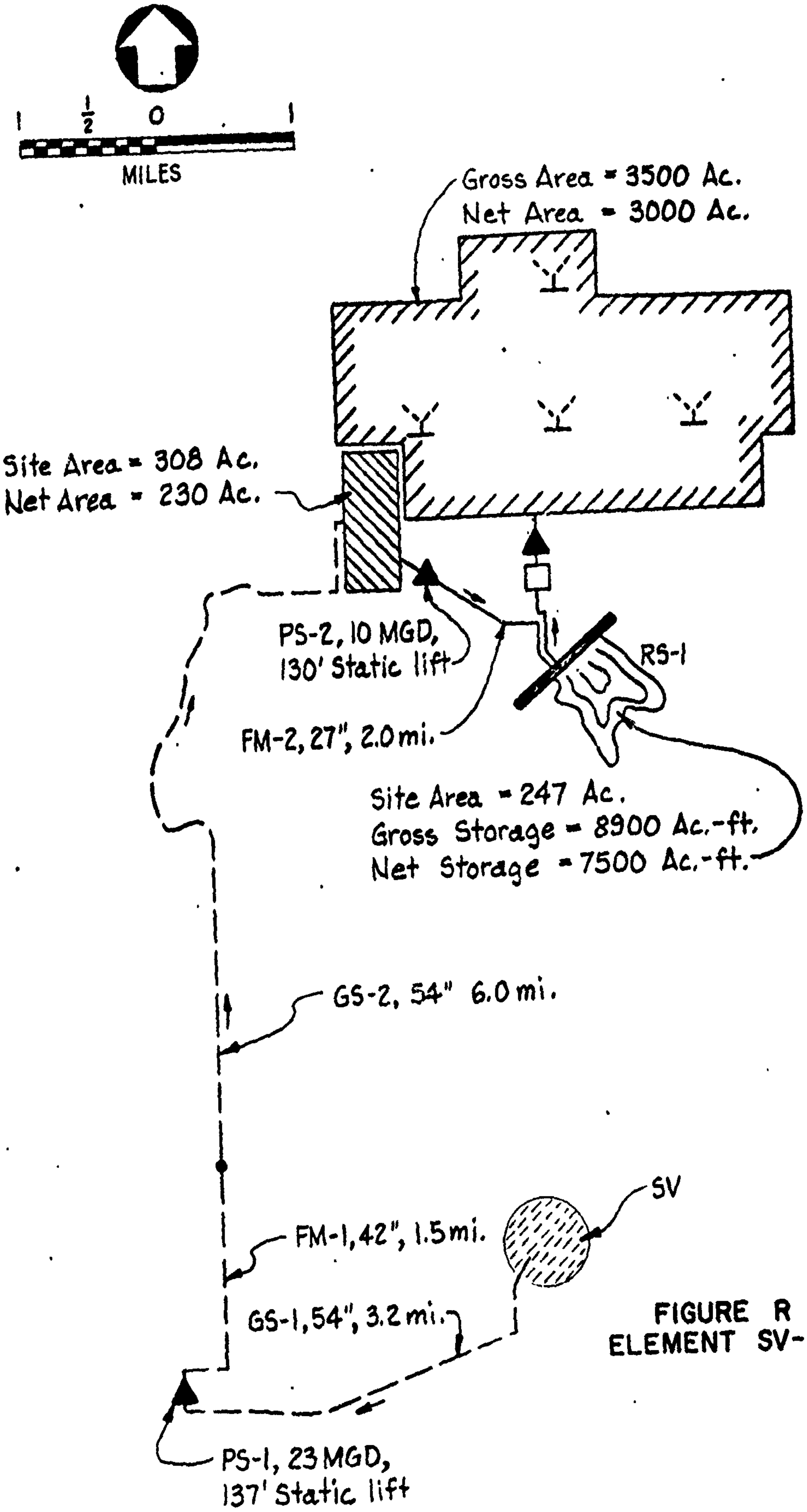


FIGURE R
ELEMENT SV-1i

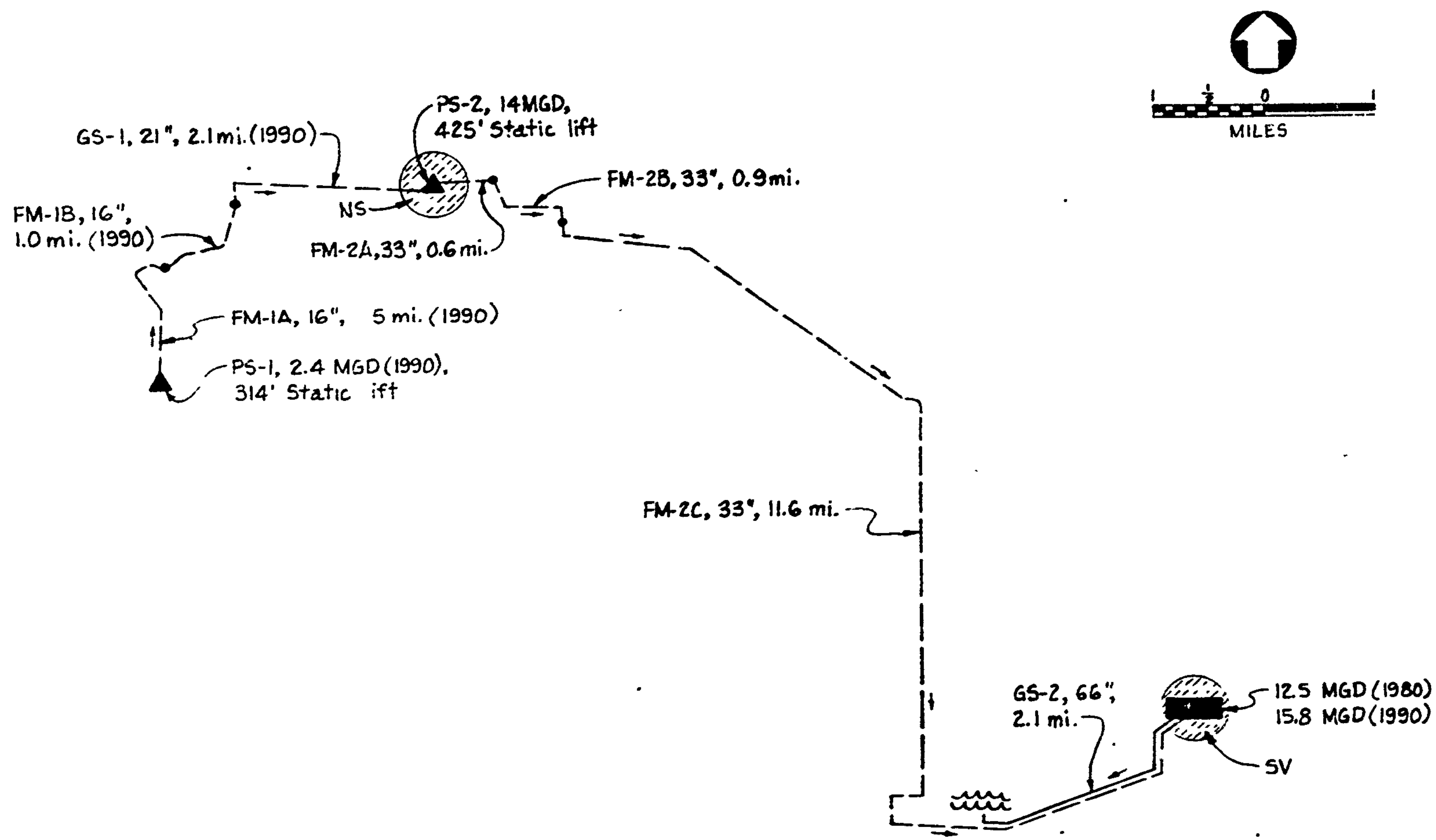


FIGURE S
ELEMENT (NS+SV)-sw

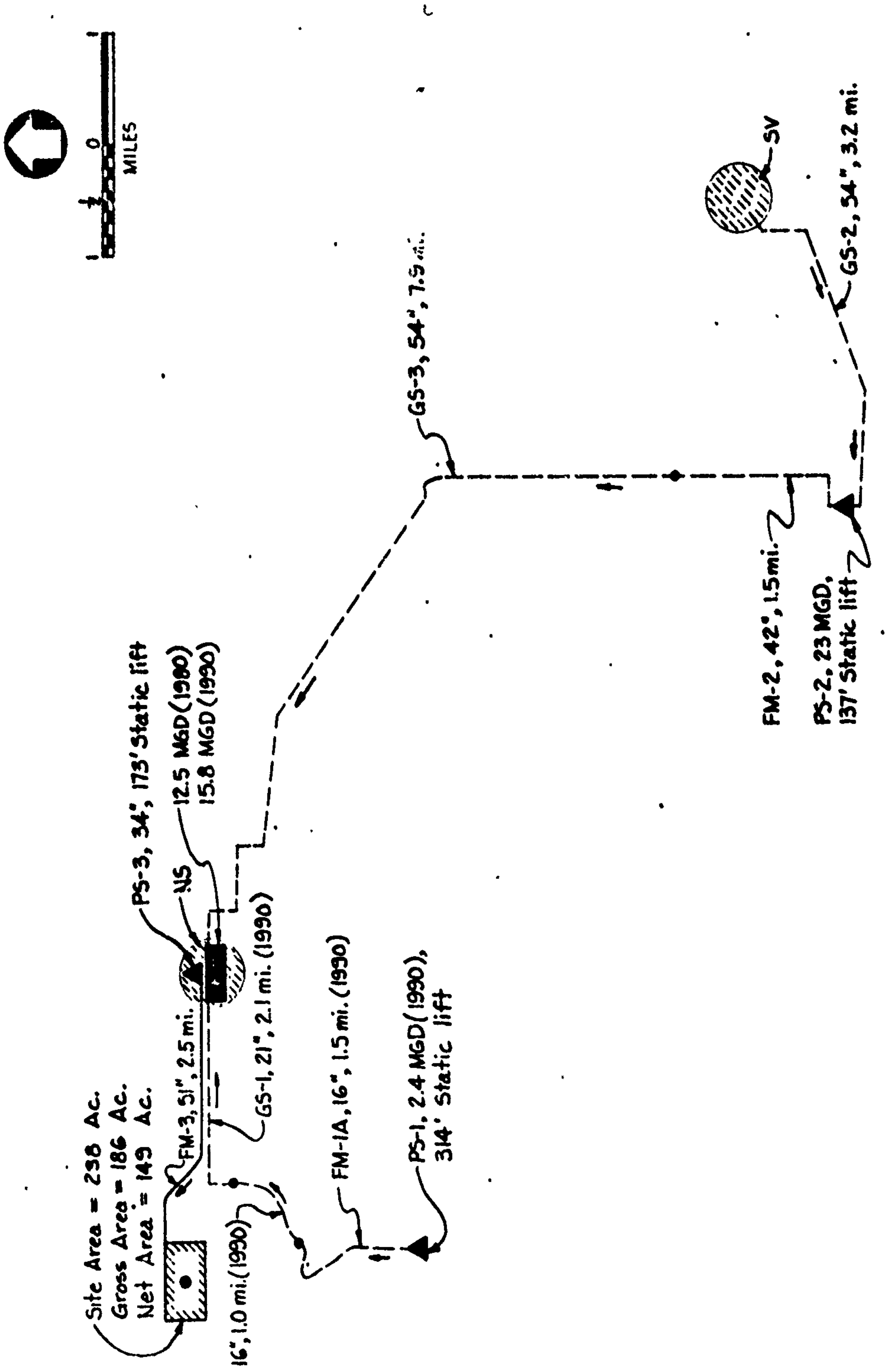


FIGURE T
ELEMENT (NS+SV)-1p

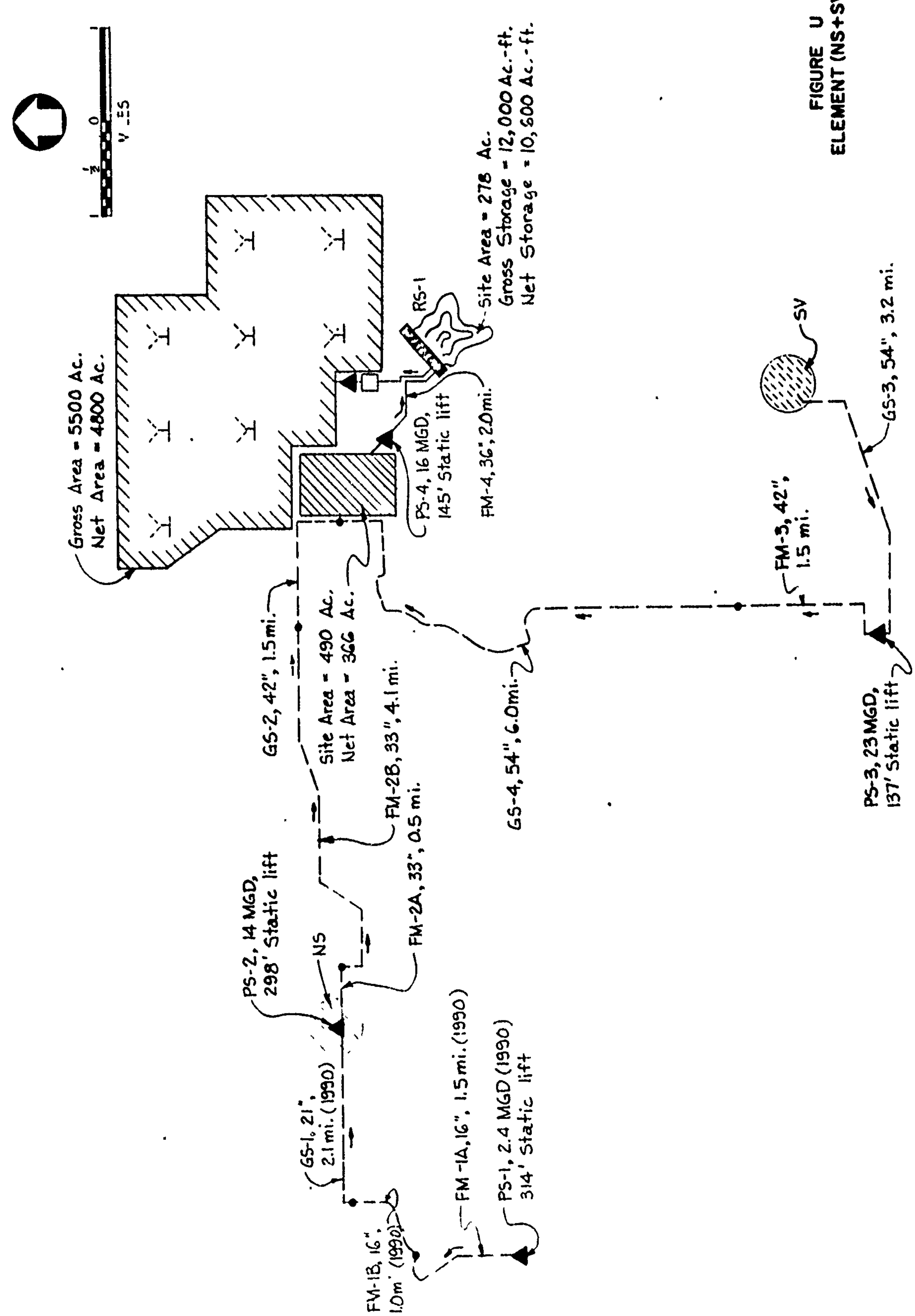


FIGURE U
ELEMENT (NS+SV)-II

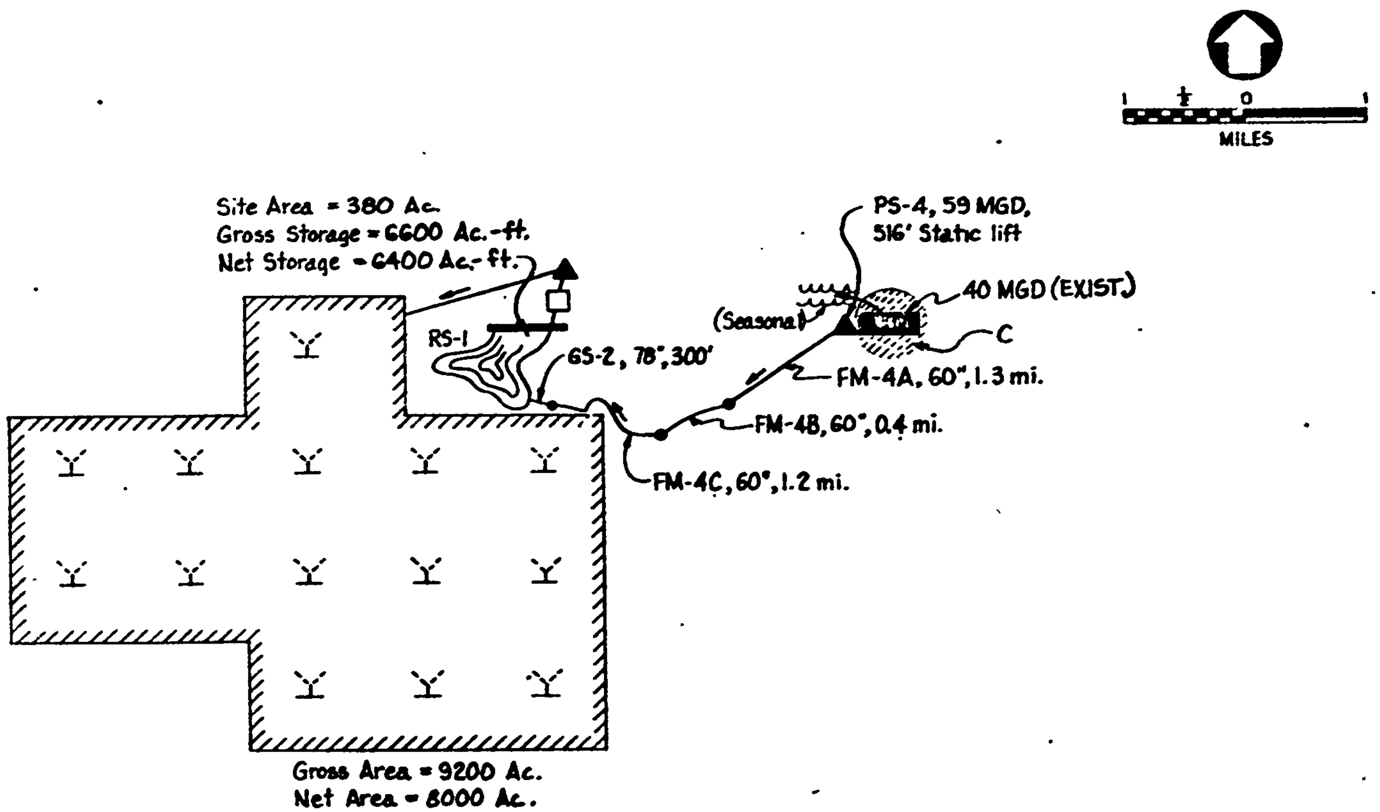


FIGURE V
ELEMENT C-H-sw

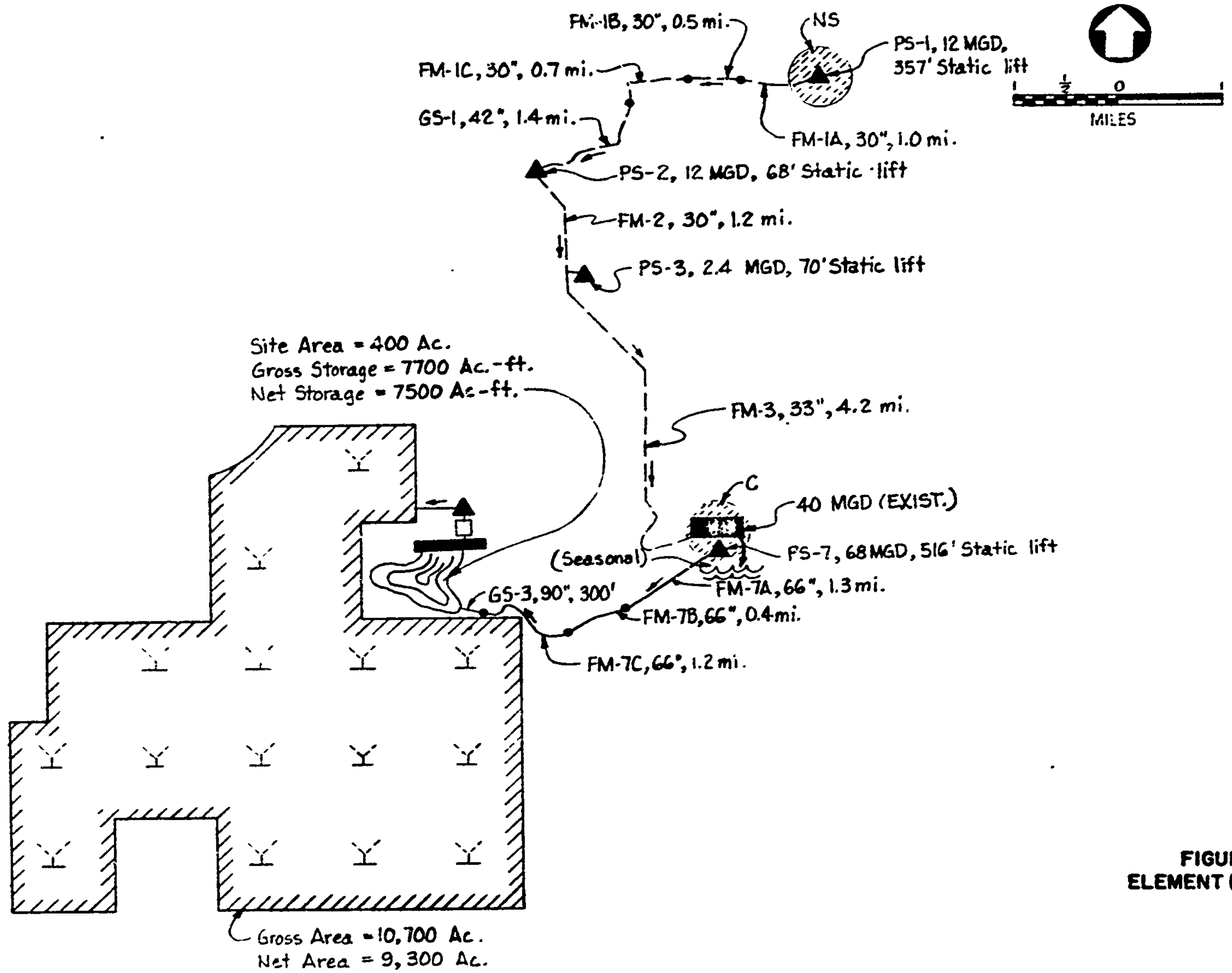


FIGURE W
ELEMENT (C+NS)-II-SW

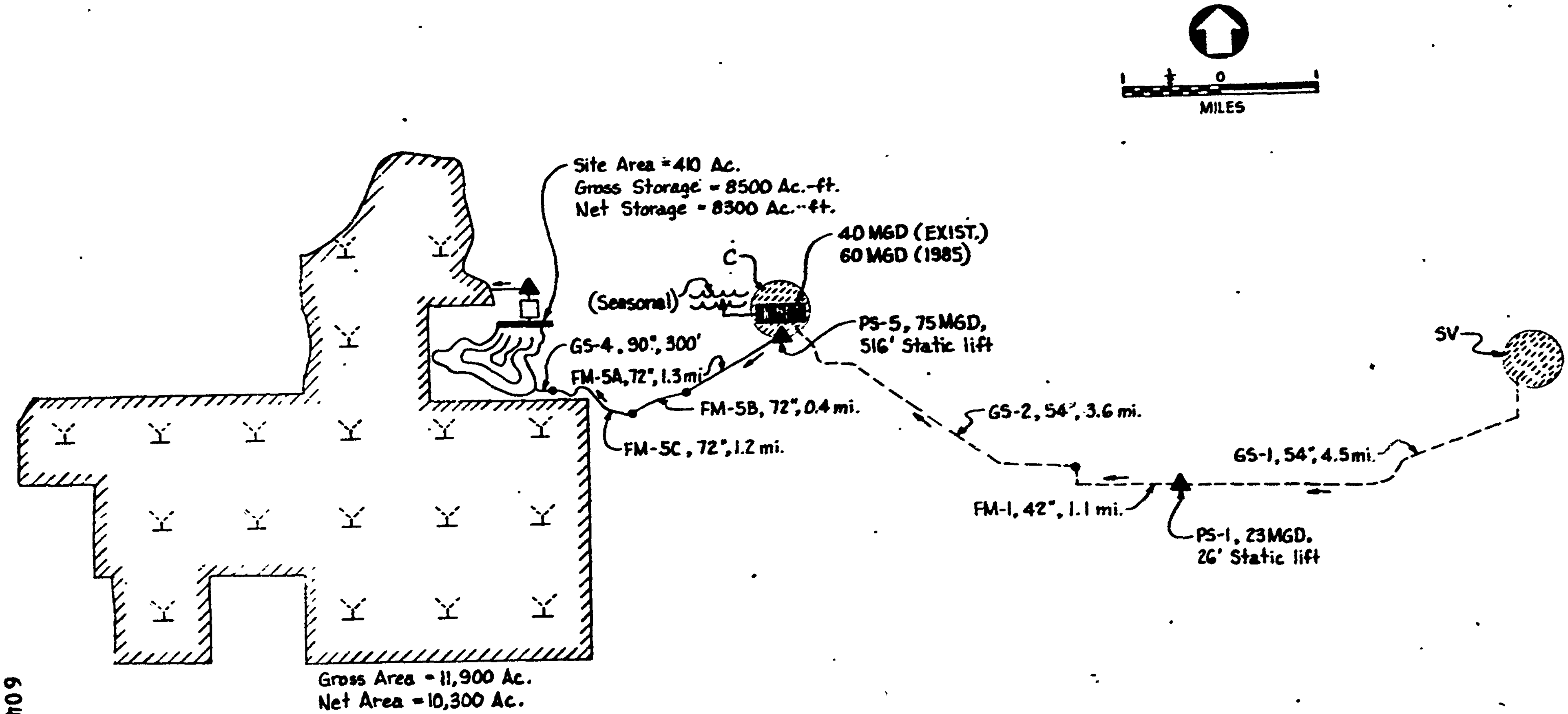


FIGURE X
ELEMENT (C+SV)-li-sw

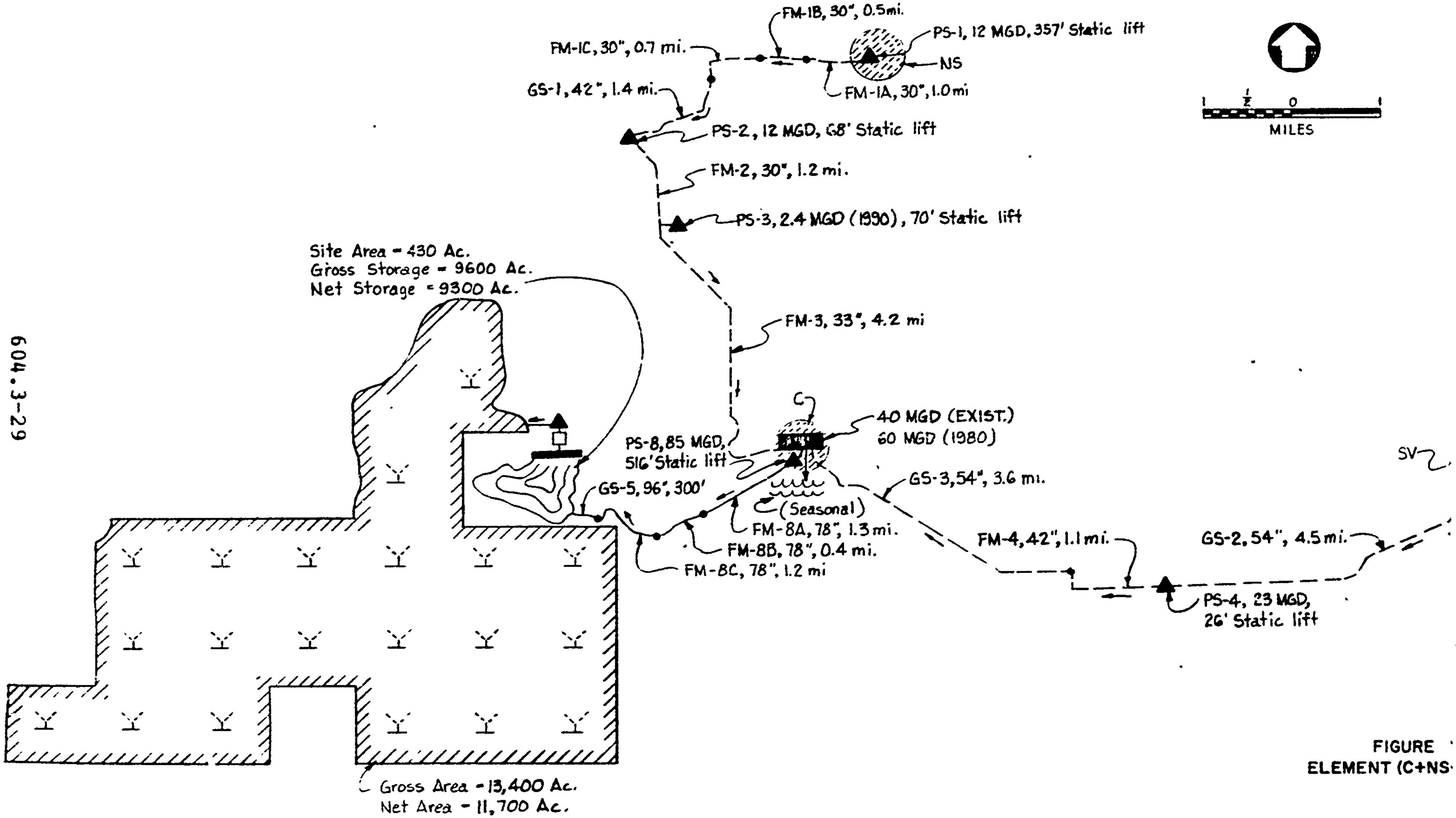
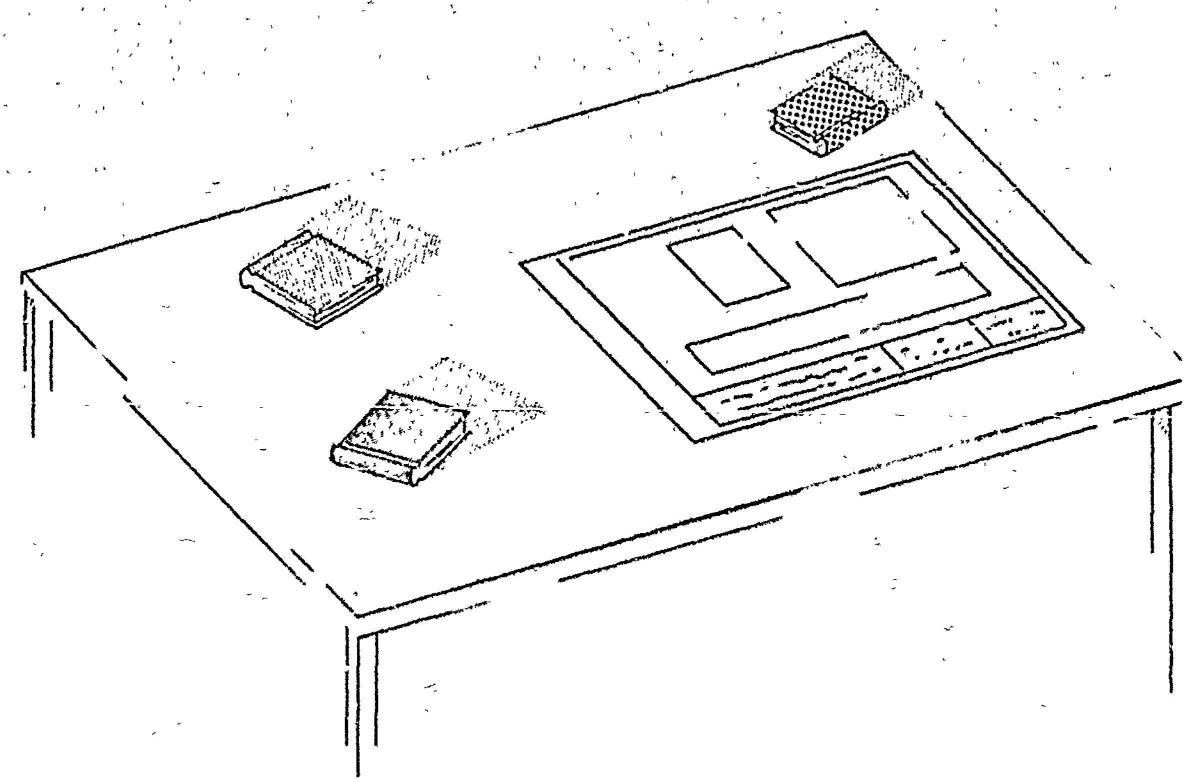


FIGURE
ELEMENT (C+NS



SECTION 604.2

FORMULATION OF ALTERNATIVE STRUCTURAL PLANS FOR WASTEWATER MANAGEMENT

WATER RESOURCES STUDY

METROPOLITAN SPOKANE REGION

SECTION 604.2

FORMULATION OF ALTERNATIVE STRUCTURAL PLANS FOR WASTEWATER MANAGEMENT

18 March 1975

Department of the Army, Seattle District
Corps of Engineers,
Kennedy-Tudor Consulting Engineers

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Department of the Army, Seattle District
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SECTION 604.2
FORMULATION OF ALTERNATIVE STRUCTURAL PLANS
FOR WASTEWATER MANAGEMENT

Objectives

The objectives of this section are to identify the full range of possible general wastewater management plans and to formulate for each of these general plans an optimized specific plan that can be subjected to cost effective analysis.

The elements considered in alternative formulation are: (1) those due to permutations and combinations of service area with basic kinds of ultimate disposal and (2) those that depend on selection of specific sites and routes to meet the needs of service area-disposal type combinations.

Elements of Candidate Alternatives

There are two fundamental elements in all alternatives that must be considered before reaching the level and complexity of site and technology specifics. These two elements are the service areas and basic disposal categories. The urban planning area contains three major service elements, the City, North Spokane and Spokane Valley. There are likewise three basic disposal alternatives available, namely: surface water, land application to irrigation and land application to infiltration-percolation. The three service areas can be dealt with in a variety of combinations ranging from all independent to all combined. The five possible combinations of service area are shown in

Table 1. From these five systems there are seven possible operating entities, the three service areas independent of each other, the three service areas paired with each other and all three combined. That is, there are seven service entities each of which has a choice of the three disposal categories making a total of 21 possible service-area and disposal combinations. These 21 alternatives as listed in Table 2 are the building blocks for all possible systems to serve the entire urban planning area. The ways in which these 21 service area-disposal subsystems alternatives can be combined with the possible combinations of the three basic service areas shown in Table 1 are shown in Tables 3.1 through 3.5. It can be seen from Tables 3.1 through 3.5 that there are 57 possible systems for the urban planning area considering only the possible combinations of service area and basic disposal alternative.

Each of the 21 building block elements that make up these systems in turn has subalternatives generated by the specifics of site selection and treatment technology. If the optimum subalternative for each of the 21 elements were known, it would be possible by cost analysis of these 21 elements to arrive at a cost ranking of all of the 57 system alternatives by addition of the elements in accordance with Tables 3.1 through 3.5.

In another section, the treatment technology for the purpose of initial screening is selected. Therefore, the optimization of each of the 21 basic alternatives resolves to the site specific considerations. This problem is addressed in the following paragraphs.

The site specific considerations are discussed in the narrative and an optimal site specific plan selected for each of the 21 elements. Tables 4.1 through 4.7 summarize critical population and flow projection data for the seven combinations of service area.

The "no action" alternative for the Spokane Valley is designated SV-na. The City "no action" alternative is equal to the City alone with disposal to surface water designated C-sw. For North Spokane "no action" is not a feasible alternative at projected growth conditions. In the foregoing described screening to rank the 57 system alternatives the City "no action" plan is automatically considered. By elimination of the SV combinations, the 12 system alternatives shown in Table 3.6 result. These twelve are also capable of being derived from elements developed in the basic 21 elements. A cost effectiveness ranking of the twelve system alternatives in Table 3.6 provides a basis for selection of optimum action if the Spokane Valley "no action" alternative is acceptable.

For the Spokane Valley, and to a limited extent the North Spokane Area, there are a number of alternatives other than those that require a conventional gravity sewer collection system to a single natural point of concentration. These other alternatives, in addition to the "no-action" alternative of continuation with individual septic tank disposal, are discussed and evaluated in another section. This section is limited to formulation of alternatives which depend upon a conventional gravity sewer collection system. The costs of the internal collection systems are not included in the initial cost-

effectiveness screening since internal collection systems are a common denominator to all.

Recycling as an ultimate disposal alternative is not precluded by the analysis in this section since disposal criteria require that any wastewater treated for recycle must meet as a minimum the requirements for disposal subsequent to reuse. This, in effect, means that recycle is simply a "pipe" between the treatment process and the ultimate disposal. Therefore, recycle can effect comparison of basic alternatives only if it creates a benefit. This evaluation can be superimposed on the basic alternative comparison as a subsequent step. Recycle potential and its effect on alternative selection is discussed in another section.

City Alternatives

From Table 2, the following 12 alternatives are found to involve the City alone or in combination*:

C-sw	(C+NS)-sw	(C+SV)-sw	(C+NS+SV)-sw
C-li	(C+NS)-li	(C+SV)-li	(C+NS+SV)-li
C-lp	(C+NS)-lp	(C+SV)-lp	(C+NS+SV)-lp

It is the purpose of the following to explore the site and treatment specific subalternatives for each of these twelve basic alternative categories to select a representative plan for each. To

*For identification of symbols, see Table 2.

introduce consideration of specific subalternatives involving the City it is first necessary to consider the unique constraints imposed by the proposed improvements to the City sewage treatment plant (STP) which have the status of accomplished fact and sunk capital cost for the purpose of this study.

Committed STP Improvement. The City is currently implementing a project which will upgrade the existing primary treatment plant to secondary treatment with phosphorus removal. The design contemplates continuing use of the existing site and continuing disposal of the treated wastewater to the Spokane River. Sludge disposal is proposed to continue temporarily using the current practice of dewatered sludge disposal to local landfill pending on-site investigation of liquid sludge disposal on remote areas. The following detailed descriptions of the proposed improvements and proposed operation are from Bovay (1973) updated by interview with Bovay Staff during October, 1974.

The expanded and upgraded plant is designed to anticipate further expansion in the year 2000 to provide for ultimate flows to the year 2025. The headworks, screening and grit removal, are to be sized for the Peak Dry Weather Flows (PDWF) of the second stage expansion. In addition to accommodation of forecast municipal wastewater flows, the expanded facility makes certain provisions for treatment of urban runoff which reaches the plant through the combined sewer system. The provisions for urban runoff treatment include a combination of hydraulic and treatment capacity with limited on-site storage.

Design criteria for stage construction of improvements are

as follows:

	Initial	Ultimate
Hydraulic capacity of headworks		
All units operating, mgd	146	146
One unit out of service, mgd	146	146
Treatment Capacity		
Design PDWF, mgd without phosphorus removal	77	115
Design PDWF, mgd with phosphorus removal	57	57
Design ADWF, mgd	40	60
Excess Flow Clarifiers, Total Volume, mg	4.5	4.5

The basis stated in Bovay (1973) for municipal waste loads projections for the initial stage of construction which is to serve to the year 2000 is a tributary population of 255,000 composed of 205,000 within the City and 50,000 in contiguous potential service areas. For the second stage expansion to accommodate forecast needs to the year 2025, the design ultimate tributary population is 289,000, including 211,000 in the City and 87,000 in contiguous potential service areas.

Proposed operation of the facility relative to combined sewer flow is as follows: The intent is to prevent any direct untreated discharge of combined flows to the river. The surcharge capacity of the influent sewer is 146 mgd. All flows reaching the plant are to be routed through the headworks for screening and grit removal. All flows up to the PDWF capacity of the plant are to be routed through

the complete treatment facility and all excess over the PDWF to the excess flow clarifiers. Stored flows up to the capacity of the excess flow clarifiers are to be subsequently given complete treatment by being pumped back to the complete treatment sequence when inflow reduction makes capacity available. If the intensity and/or duration of the combined flow exceeds the storage capacity of the excess flow clarifiers, the excess is discharged through chlorine disinfection to the river with the excess flow clarifiers acting as primary treatment.

Implications of the Improvement. The combined sewer area presently tributary to the treatment plant is approximately 16,000 acres. Much of the stormwater from this area cannot reach the treatment plant due to lack of capacity in the interceptor sewers and is consequently overflowed along with the mixed municipal wastewaters at the many overflow locations along the Spokane River. Esvelt & Saxton/Bovay (1972) calculated that the runoff from the combined sewered area would exceed 300 cfs (192 mgd) for 10 hours per year or 750 cfs (480 mgd) for 1/2 hour.

The City of Spokane has filed a schedule and projected cost estimate for staged planning and construction for a program to resolve the combined sewage overflow problems of the City. For the purpose of development of alternative plans involving the City, it is assumed that a plan for resolution of the combined sewer overflow problem will be realized and that the City wet weather flows reaching the improved STP will not exceed 146 mgd.

Relation of Proposed Capacity to Forecast Flows. The

following table indicates forecast flows developed in this study at years 1980, 2000 and 2020 of various service elements in and contiguous to the City:

	Forecast Flows, mgd ADWF		
	Year 1980	Year 2000	Year 2020
Area presently sewered to existing City STP site	29.55	33.18	35.28
Moran Prairie Planning Unit	0.38	0.89	1.30
Southwest Planning Unit	0.10	0.18	0.28
Subtotal	30.03	34.25	36.86
Area in North Planning Unit			
Inside City Limit	.31	1.24	2.03
Subtotal	30.34	35.49	38.89
Area in North Planning Unit			
Outside City Limit	2.08	4.55	5.91
Subtotal	32.42	40.04	44.80
Spokane Valley	7.03	10.03	12.19
TOTAL	39.45	50.07	56.99

The forecast indicates that the proposed initial capacity of the STP improvement at 40 mgd ADWF would be adequate to serve the City, including Moran Prairie and Southwest Planning Units, plus North Spokane to the year 2000. The 40 mgd would be adequate to also include the Spokane Valley at year 1980 but not beyond that date. If the Spokane Valley is combined with the City in lieu of North Spokane, the 40 mgd capacity would be adequate to about 1985.

Construction of the second stage of proposed improved capacity to a total of 60 mgd would be adequate to serve the entire urban planning area to year 2020 and beyond.

The service population forecasts prepared for this study are in substantial agreement with the forecast developed by Boyay (1973) on which STP expansion sizing was based. Bovay (1973) forecast 205,000 and 211,000 for City service area respectively in years 2000 and 2025 as compared with this study forecast of 199,700 and 221,600 for years 2000 and 2020.

Further Improvements to Treatment Quality. The existing City STP site is severely restricted topographically with respect to availability of land for further expansion beyond the proposed second stage of 60 mgd secondary treatment with phosphorus removal. As shown above, the 60 mgd capacity is more than adequate for the entire urban planning area. The addition of space consuming processes for more advanced treatment will create siting problems, however, since the expansion to 60 mgd at secondary level will substantially fill the area.

The addition of seasonal nitrification by ammonia stripping is judged to be feasible at the present site. The addition of advanced treatment to include year around nitrification and denitrification, mixed media filtration and carbon adsorption are not judged to be feasible at the present site for either a 40 mgd or 60 mgd plant. For advanced treatment to interpreted 1985 standards, these additional facilities must be located at another site.

Surface Water Disposal. The presently planned facility will

provide secondary treatment with phosphorus removal. In addition a possible requirement for seasonal nitrification is judged to be desirable to eliminate a potential threat of ammonia toxicity. See the section on disposal criteria. It is feasible to provide seasonal nitrification in the proposed enlarged and upgraded facility by seasonally unloading the activated sludge reactors by shifting the chemical precipitation for phosphorus removal from the secondary to the primary. Additional aeration capacity is judged to be necessary to achieve the required level of nitrification in the activated sludge reactors under this condition.

The foregoing will meet disposal requirements for discharge to the Spokane River at the STP site until such time as more advanced treatment is required in 1990 to meet the interpreted level corresponding to "no discharge of pollutants." The interpreted level of treatment corresponding to "no discharge of pollutants" is, in addition to secondary treatment and phosphorus removal, year around nitrification-denitrification, mixed media filtration, carbon adsorption, and ozone disinfection. Since these additional facilities cannot be accommodated on the present site, their inclusion requires pumping of the effluent from the present site to another site for the continuation of the treatment process. The bench adjacent to the river in the vicinity of the Downriver Golf Course appears to be physically feasible for this purpose.

There are no alternatives with respect to location of point of discharge to surface waters except to convey the effluent down-

stream from Long Lake, a distance of over 20 miles. There are no potential cost advantages to this since the same level of treatment is required for both sites. No further consideration is given to surface water disposal at sites other than at the City STP.

For all surface water disposal alternatives which can be met by planned City STP improvements and expansions and other additions which will fit on the site, the basic structural alternative consists of treatment at the City STP and discharge of effluent to the Spokane River at the City STP site.

Alternative C-sw. Since the forecast flow for the City including Moran Prairie and Southwest planning units is less than 40 mgd to year 2020, no future capacity expansion is required. The City service area, except Moran Prairie and Southwest is already sewered to the STP site; there are no transport elements required for the City service area. Moran Prairie and Southwest, although presently unsewered, are not regarded as involving a transport cost chargeable to alternatives but rather as a growth extension of the City sewer system.

Alternative (C+NS)-sw. The forecast flow to the year 2000 for this combination is 40 mgd. Again, no further expansion of the planned improvement is required throughout the cost-effectiveness comparison period. Beyond year 2000, a capacity expansion is required.

Transportation is required to bring the North Spokane wastewater from their natural point of concentration to the City STP. There are two basic alternative routes for the conveyance. One is around the northwest side of Five Mile Prairie and the other is around

the southeast side. The northwest route is shorter and through undeveloped area whereas the longer southeast route is through built up area. The northwest route also involves a lower pumped lift. The northwest route is selected.

If the proposed City STP upgrade were not to be regarded as an accomplished fact, two other alternatives for this combination of service areas would be considered. One would be to abandon the existing site except for use as a site for equalizing storage and a pump station, and transport both City and North Spokane wastewater flows to a new treatment site near the confluence of the Spokane and Little Spokane Rivers. The other would be to continue primary treatment of City flows at the existing City STP site and convey primary treated sewage to a new site near the confluence for secondary treatment. Primary treatment for the North Spokane flows would be required at the confluence site. For surface water disposal the higher cost of conveying the larger City flows to the confluence site would more than offset any reducing in cost of conveying North Spokane flows to the City STP site.

Alternative (C+SV)-sw. The forecast flow for this service area combination is 44.28 mgd at year 2000 and 49.05 mgd at 2020. Therefore, capacity expansion beyond the first planned increment at 40 mgd is required for both the cost effectiveness period and beyond.

There are two basic transport alternatives for the wastewater flows from the Spokane Valley. One is to either parallel or reinforce the size of the City interceptor system which follows the river. The other is to seek a more direct route across the City

utilizing more pumping lift. Since there is essentially no spare capacity in the existing interceptor system, a complete parallel would be required. The longer route and more difficult construction conditions of a route parallel to the river is evaluated as more costly than the additional pump lift for a more direct route utilizing the general alignment of Mission and Northwest streets.

Alternative (C+NS+SV)-sw. The forecast flows for this combination of service areas is 50 mgd and 57 mgd at years 2000 and 2020 respectively. Therefore, as for alternative (C+SV)-sw, capacity expansion beyond the first planned increment of 40 mgd is required within the cost effectiveness period but is then adequate to 2020.

The transport alternatives are as previously discussed for (C+NS)-sw and (C+SV)-sw plus an additional alternative of pumping from the Spokane Valley to North Spokane via the eastern edge of the City for flow through the North Spokane system to the North Spokane point of concentration, there to be pumped to the City STP together with North Spokane flows around the northwest side of Five Mile Prairie. However, pumping the Spokane Valley sewage via North Spokane point of concentration is not cost effective and is considered no further.

There are theoretical alternatives which would involve concentration to other sites than the City STP. The relative magnitude of the flows, the City being over 3 times SV and almost 6 times NS at year 2000, highly favors transport of the smaller flows. Thus the City as point of concentration would be favored even if there were not a "sunk cost" facility at that site.

Land Application Alternatives

The three land application alternatives are irrigation, overland flow and infiltration-percolation. Overland flow is tentatively eliminated for lack of available land of suitable impermeability and slope. All land application techniques require prior wastewater treatment to equivalent of a minimum of secondary effluent. Thus all irrigation alternatives (1i) are to consist of application of secondary effluent to irrigation and all percolation alternatives (1p) are to consist of application of secondary effluent to infiltration-percolation.

Irrigation. Irrigation cannot actively be applied during the freezing season. Therefore, this disposal method requires either storage during the non-irrigation season or an alternative method of disposal. Thus, the subalternatives to irrigation application in general are: (1) the disposal of the entire year's effluent to irrigation through utilization of storage, and (2) the disposal of effluent to irrigation during the irrigation season with disposal to surface water or infiltration-percolation during the remainder of the year. Since these subalternatives have significantly different impacts on non-cost evaluation factors one cannot be selected over the other as representative. Both must be formulated for cost-effectiveness evaluation so that the cost elements may be weighed against the non-cost evaluation factors.

The primary category of alternatives faced by all combinations of service area with the City is that of selection of the irrigation lands. The primary variables for consideration are availability

of adequate areas of suitable land, and the distance and difference in elevation from the point of concentration of the wastewater.

To put land disposal by irrigation into perspective, it must be recognized that the treated wastewater potential from the City alone or in combination with the rest of the urban planning area will equal or exceed the current water consumption for agricultural irrigation for the entire study area. The estimated 1980 wastewater flow, not including urban runoff, is 34,000 acre feet per year for the City alone. The estimated current water consumption for agricultural irrigation for the entire study area is 36,000 acre feet per year, of which 21,600 are in the Spokane Valley, 6,500 are in the Little Spokane Valley and the remaining 7,900 are throughout the remainder of the study area (see Table 21 of Section 313-14). For the entire urban planning area at the design year 2000, the forecast wastewater potential is 56,000 acre feet per year or more than 1.5 times the current agricultural irrigation use for the entire study area. This means that irrigation alternatives must look toward bringing additional lands under irrigation.

Potential irrigation sites other than the Spokane Valley are described in the U. S. Bureau of Reclamation (1973) report to the City of Spokane. The description of the properties and characteristics of these areas are quoted in the Appendix. The USBR report forecloses consideration of the Spokane Valley on the grounds that it would be rejected by public opinion. This study is based on the premise that all technically feasible alternatives that can meet Federal and State requirement must be kept open for evaluation through the decision-

making process. The U.S.B.R. sites are discussed first, followed by a discussion of the Spokane Valley weighed against the U.S.B.R. sites.

Additional irrigation sites are investigated under alternatives which do not include the City and therefore require substantially smaller areas.

The sites described by the USBR as having potential are listed below with their maximum areas and elevation range; similar data for Spokane Valley are added:

Location	Elevation Range, Feet	Maximum Area, Acres per USBR
Fairchild	2300 to 2420	5,000
Down River	1760 to 1860	2,700
North (Little Spokane Valley)	1850 to 2000	80,000
Scabland	Not given	Not given
Riverbench	Not given	Not given
Spokane Valley	2000 to 2100*	10,000*

From an area, elevation, soil and crop standpoint the North area, which is better described as the Little Spokane Valley in the vicinity of Deer Park, appears to be the most advantageous. The USBR report develops a detailed system based on 39.4 mgd ADWF at year 2000 which involves terminal storage of 24,000 acre feet active storage (28,000 acre feet gross to provide 2,000 acre feet minimum pool and 2,000 acre feet surcharge) and irrigation of 16,000 acres. These

*Not U.S.B.R. data.

figures are in substantial agreement with those developed in Tables 4.1 to 4.6 which give 29,900 acre feet as required active storage and 12,100 acres of irrigation for ADWF 40.04 mgd corresponding to City plus North Spokane service area at year 2000. Tables 4.1 to 4.6 show a range of from 10,400 acres irrigation and 25,600 acre feet of storage for the City alone at year 2000 to 15,200 acres and 37,400 acre feet of storage at year 2000 for the entire urban planning area. The USBR report shows a feasible storage site in Section 30 of T28N, R42E, south of Mud Creek, with water surface elevation 2212 which would provide gravity feed to irrigable lands at 1850 to 2000 feet elevation. Between the City STP and the storage site is a high point to pump over at elevation 2225. The net lift from the STP site at 1689 to the high point is approximately 530 feet. The approximate distance from STP site to terminal storage is 17 miles.

The Fairchild Site Area is given as 5000 acres but the caution is added by USBR that further investigation of depth to bedrock is required to determine application which would not create drainage problems. For this reason, an application rate of 1.0 inch per week average for a 24 week season is used as an application criterion. This is equal to 2.0 feet per season. Computed requirements shown in Tables 4.1 to 4.6 indicate that this area is too small for year around disposal and marginal for seasonal application. Note that unlike the Spokane Valley with a ready source of alternative irrigation supply, this area has practically zero local potential. Therefore, the treated wastewater would have to supply the full irrigation season, beginning in the last part of April and extending through into the first part of October.

Terminal balancing storage of at least 2 months demand would be required to match wastewater availability variations to irrigation demand. A potential terminal reservoir site appears to be possible by building a dam across the swale in which Old Trails Road is located in section 5 and 6 of T25N, R42E only about 3 miles west of the STP site. Water surface elevation would be about 2150 necessitating pumping to the irrigated lands which range from 2300 to 2400 feet. The net lift from the STP site at elevation 1689 to the median elevation of irrigable land is of the order 600 feet. There is little cultivation at present in this area.

The Down River Area, on a terrace adjoining Long Lake, with only 2700 acres available is too small for either year around or seasonal disposal by irrigation. The high permeability of the site, however, does make the site a potential for infiltration-percolation disposal. There is no cultivation in this area at the present time and much of the land has not been cleared of the Ponderosa Pine cover. Clearing a relatively small portion for utilization by infiltration-percolation is selected as a more appropriate alternative for this site.

Scablands Areas are those southwest of Fairchild AFB which have very little soil cover as a result of the scouring action of the Missoula Flood. Refer to the section on Geology. As indicated in the USBR report, irrigation for crop production would be impossible for lack of soil. The USBR suggested application would be for irrigation of native cover to create improved wildlife habitat. The elevations in this area south of Waukon are around 2400 feet and begin to slope

south into the Palouse Drainage Basin. The combination of distance, 20 miles, elevation, a lift of over 650 feet, and the potential benefit make this site a "last resort" alternative. This alternative is set aside pending "first cut" evaluation of other alternatives.

<u>River Bench Area</u> is identified as the terraces of permeable material in the vicinity of the confluence of the Little Spokane River with the Spokane River and is on the surface of the primary aquifer northwest of Five Mile Prairie to where it narrows to pass through the gap formed by the Nine Mile Falls outcrop. The proximity of this site to highways, parks and development together with its small area preclude its consideration for irrigation disposal. The site does have feasibility for an infiltration-percolation disposal site.

In addition to the foregoing possible alternatives for land disposal based on the suggested sites in the USBR report, other potential areas are:

1. The present dry cropped areas northwest of Spokane on Four Mound and Indian Prairies.
2. The present dry cropped lands in the Hangman Creek Valley.

These areas have no outstanding advantages over areas already under consideration that are closer and at a lower elevation. Furthermore these areas are already economically productive under dry farming and would not be subject to as great an incremental benefit by irrigation. Therefore, these areas are set aside from further consideration pending fuller evaluation of more favorably situated areas.

Considering the Spokane Valley as a potential site for

irrigation disposal, the requirements for area are based on an application rate of 5.5 feet per season. Reference to Tables 4.1 to 4.6 shows that for design year 2000, the required area ranges from 7,000* acres for a service area limited to the City to 10,200* acres for a combined service area to include the entire urban planning area. The gross land area of the Spokane Valley east of Spokane Industrial Park to the Idaho state line is approximately 13,000 acres including the side valleys at Newman and Liberty Lakes. Of this total gross area 5,100 acres are presently under irrigation, served by irrigation districts. There is a considerable scattered residential development throughout the area which reduces the gross area available for treated wastewater irrigation. Extensive relocation of residents would probably be necessary to create a potentially irrigable area of 7,000 to 10,200 acres. The gross land area appears to indicate physical feasiblity so that this alternative cannot be eliminated on such grounds.

A companion requirement to land availability is availability of a storage site if utilization of the total annual flow is to be made for irrigation. The required storage for 8 months, 7 months of no irrigation plus 1 month start-up, are shown in Tables 4.1 to 4.6 to range from 25,600 acre feet at design year 2000 for the City alone to 37,400 acre feet for the entire urban planning area. Again, to put the problem into perspective, note that Newman Lake has a volume of 22,000 acre feet and covers 1198 acres (average depth 18 feet). Given

*Note that these are net farm areas not including access roads and buffer zones.

a dam of sufficient height in the mouth of Canfield Gulch, this volume of storage would be physically possible. The larger volume (37,400 acre feet) could probably be achieved with a height of approximately 150 feet.

The elevation at the effluent of the City STP is approximately 1689. The elevation of the Spokane Valley floor ranges from 2000 at Spokane Industrial Park to 2100 at the Idaho state line. The probable water surface elevation of a storage reservoir in Canfield Gulch is 2300 to 2350 feet. The lift from plant effluent to storage reservoir is of the order 600 feet. The present pumping lift of wells in the Spokane Valley is of the order 80 to 100 feet. The energy premium is a lift of 500 feet plus friction loss to pump a distance of approximately 20 miles.

The Spokane Valley on the basis of required lift and conveyance distance is less favorable than the Little Spokane Valley and the required area availability is marginal. Additional considerations unfavorable to the Spokane Valley are the present availability of an adequate irrigation water supply and the numerous small ownerships and population density. To bring reclaimed wastewater to the Spokane Valley as a replacement for the present adequate supply would provide no potential economic benefit to the area. The numerous small ownerships and population density would cause implementation problems and have high dislocation potential.

For all of the above reasons, the Spokane Valley is judged less suitable than the Little Spokane Valley for City involved alternatives.

From the foregoing alternative irrigation sites, the Little Spokane Valley and that portion known as Williams Valley specifically is selected as the most feasible and to be representative of the best potential full year disposal by irrigation for all City involved alternatives. All City combinations have in common the utilization of the proposed expanded City STP to provide the necessary secondary treatment prior to irrigation application. The transportation problem from the City STP site to storage site and irrigated area is well defined by topography so that there is essentially only one feasible pipeline route. The topography likewise provides only one favorably situated terminal storage site. This pipeline route and storage site, both as defined by topography, are common to all City service area combinations for irrigation application to the Little Spokane Valley. The selection of land areas for irrigation is based on application to suitable land nearest the terminal storage to minimize distribution costs. The detailed City associated irrigation alternatives are defined as follows.

Alternative C-li. See alternative C-sw for discussion of utilization of the City STP for forecast flows. The facilities required for conveyance of the secondary treated effluent to the Williams Valley irrigation lands includes effluent pumping of unequalized flows, equalization storage as near the STP as possible, sewer to a low point near the mouth of the Little Spokane River, repumping facilities and pipeline to the terminal storage site, terminal storage reservoir, distribution piping from terminal storage to irrigated lands and sprinkler application facilities in the fields. A groundwater quality

monitoring network is an integral requirement.

Alternative C-li-sw. For a subalternative in which only seasonal disposal is to irrigation and the remainder of the year is to surface water the nearer Fairchild site (actually north of Airways Heights) is selected as more cost effective. It must be recognized that this alternative would prove difficult to upgrade to interpreted 1985 standards since it would require either construction of advanced facilities for off season surface water disposal or the expansion to another site to find adequate land for full year irrigation disposal.

The conveyance requirements for this subalternative involve a relatively short force main crossing the Spokane River but a high pump lift to the reservoir site in Old Trails Road canyon.

Alternative (C+NS)-li. See alternative (C+NS)-sw for utilization of City STP capacity and for transport to combine the NS flows at the City STP. The facilities for irrigation application and its subalternatives are as described above for alternative C-li.

Another possible alternative to be considered for this combination is the provision of separate secondary treatment for North Spokane area, by either a treatment plant or lagoons, for combining with the City effluent in the vicinity of the repumping facility at the mouth of the Little Spokane River. Consideration of this alternative involves evaluation of the trade off between separate treatment and the additional conveyance distance to combine the raw flow to the City STP. Evaluation indicates that conveyance of the North Spokane flow to the City STP is more cost effective.

Alternative (C+SV)-li and (C+NS+SV)-li. See alternative (C+SV)-sw and (C+NS+SV)-sw respectively for utilization of City STP capacity and for transport to combine SV flows at the City STP. The facilities for irrigation application and its subalternatives are as described for alternative C-li.

Overland Flow requires approximately the same land area as irrigation. The opportunities for its application are, however, less prevalent due to the more restrictive requirements for a relatively impervious soil in combination with a relatively narrow range of moderate slope. There is also the fact that it is not compatible with practical income producing farming. The method also is not a form of land disposal being rather a form of land treatment necessitating ultimate disposal of the collected runoff to surface waters.

In the particular case of application to the treated wastewaters from the expanded City STP, only one of the sites discussed above as candidates for irrigation appears to have potential for overland flow as an alternative. This is the Fairchild site which is only large enough for seasonal volume rather than year around volume. If used for seasonal treatment, it would require a return flow to surface waters via Deep Creek and back into the Spokane River at the time of year when least desirable. The quality would be better than secondary effluent but the overland flow capability for phosphorous removal is questionable for the 85 percent removal goal.

Since irrigation at this site appears to be more advantageous the overland flow alternative is set aside pending evaluation of

irrigation at this site. If irrigation of this site compares favorably with other alternatives, the overland flow option can be reopened with the possibility of adding a feature like an artificial recreational lake in Riverside State Park to hold the reclaimed water for release into the Spokane River at a more favorable season.

Infiltration-Percolation opportunities are possible at four sites discussed above, the Spokane Valley, Little Spokane Valley, Down River and Confluence. The more distant candidates, the Spokane Valley and Little Spokane Valleys are discounted primarily for distance and elevation relative to the two nearby sites. There is also to be considered the fact that return of the treated wastewater flows to the Spokane Valley or the Little Spokane Valley impacts more extensive bodies of groundwater that are in active use for domestic water supply. This is not to say that disposal by infiltration-percolation may not be feasible but that it does pose additional problems and concerns.

Both the Down River and Confluence sites constitute an indirect return via groundwater to the Spokane River. Percolation through the soil materials above the groundwater is expected to provide a very high degree of phosphorus removal so that use of these disposal alternatives would not require removal by chemical means at the City STP and at the same time would protect Long Lake from phosphorus, not only seasonally but year around.

The infiltration-percolation method provides no significant reduction in nitrogen. To completely protect the groundwater from additional nitrate concentrations would require nitrogen removal

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The infiltration-percolation method provides no significant reduction in nitrogen. To completely protect the groundwater from additional nitrate concentrations would require nitrogen removal

tial impact on groundwaters and does not require prior nitrification or denitrification. Topography essentially defines the transport route from the City STP to the Down River site so that there are no significant transport subalternatives.

Infiltration-percolation is feasible on a year around basis although there may be operating difficulties during freezing weather particularly to short cycle intermittant loading techniques used to maximize nitrification. The required facilities for all "1p" alternatives as applied to City combinations include effluent pumping, equalization storage, repumping, effluent transmission mains and multicell percolation ponds with distribution piping. As for irrigation alternatives, a complete groundwater quality monitoring network is an integral part of the proposed operating systems.

Alternatives C-1p, (C+NS)-1p, (C+SV)-1p and (C+NS+SV)-1p. See the respective City surface water disposal alternatives for utilization of the City STP and for transport to bring all wastewater flows to the City STP.

All alternatives use the Down River disposal site with the effluent transport facilities described above, sized as appropriate to each service area combination.

Alternatives Involving Other Treatment Sites

Since the proposed expanded and upgraded City STP is regarded as an accomplished fact and a sunk cost for the purpose of this study, it is unlikely that abandonment of this facility in favor of another

site would be cost-effective. It is necessary, nevertheless, to explore other possibilities for potential environmental advantage that may be evaluated as worth the additional cost.

The primary environmental advantage that could be explored at another more spacious site is reduction in energy consumption. The activated sludge process has a high energy consumption compared with lagoon systems of treatment. The only nearby site with sufficient area for lagoon treatment is the area north of Airways Heights. The required 600 foot lift to this site requires more than twice as much energy as the activated sludge process which completely negates the original goal of seeking a lagoon site. A further problem would be protection of the basalt aquifer from percolation of raw sewage from an extensive pond system.

A possible flood threat is one undesirable environmental impact that is associated with the existing site. Flood potential has been investigated by Bovay (1973) and the site declared safe from 100 year flood flow. Refer to the environmental impact statement filed for the plant enlargement for other impacts.

Other site alternatives should also be considered if they would significantly improve the ability and cost effectiveness of service to the remainder of the urban planning area. A plant site at the confluence of the Little Spokane River was considered and rejected by the City of Spokane in the process of deciding to proceed with the proposed enlargement at the existing site. The possible reduction in cost for North Spokane conveyance is more than offset by the increased

cost of City conveyance and Spokane Valley conveyance. These factors and the fact of an enlarged plant at the existing site severely inhibit consideration of a relocation of City of Spokane treatment facilities as a potential alternative plan.

North Spokane Alternatives

From Table 2, the following six alternatives are found to involve the North Spokane service area as an independent entity or in combination with Spokane Valley.

NS-sw	(NS+SV)-sw
NS-li	(NS+SV)-li
NS-lp	(NS+SV)-lp

All alternatives in which the North Spokane area is combined with the City or the City and Spokane Valley are covered in the foregoing discussion of City alternatives.

It is the purpose of the following to explore the site and treatment specific subalternatives for each of these basic alternative categories to select representative plans for each.

The natural point of concentration of NS wastewater flows is in the vicinity of the Fish Hatchery. The North Spokane service area includes some areas that are inside the City limits of Spokane. These City areas contribute about 15 percent of the forecast 1980 flow and about 25 percent of the forecast 2000 flow. A subalternative could consider combining these areas with the City when the remainder of the

NS area is not combined with the City. For initial screening this subalternative is judged to not significantly effect the selection of basic systems. Therefore, it is not considered at this point but rather left for consideration when the basic plan is indicated and institutional considerations are also being evaluated.

Alternative NS-sw. The nearest surface water to the point of concentration is the Little Spokane River. This stream has limited receiving capacity for even highly treated effluents. The 10-year 7-day low flow of the Little Spokane River at Dartford is 92 cfs. The accretion below Dartford due to groundwater discharge to the river is of the order 200 cfs and believed to be fairly constant but of unknown variability. The total low flow in the Little Spokane River just downstream from the major groundwater inflow, in the vicinity of the State Fish Hatchery, is probably of the order of 250 cfs. The forecast year 2000 flow from NS is 5.8 mgd or 9.0 cfs. This approaches the minimum dilution conditions required by State policy which indicate that 20 to 1 dilution is minimum for tertiary effluents and that an oxygen sag of over 0.2 mg/l is unacceptable. An interim discharge to the Little Spokane in the vicinity of the Fish Hatchery would be feasible at lower wastewater flows, for example, the 1990 forecast flow of 3.9 mgd. The minimal available dilution and consequent requirement for a very high degree of treatment suggest seeking an alternative surface water disposal site (and limiting consideration of SW to Little Spokane for interim facility development only).

Disposal to the Spokane River in the vicinity of the Little

Spokane confluence approximately 4.9 miles from the NS point of concentration is feasible and requires treatment not less than secondary plus phosphorous removal. Since the Long Lake water surface backs up to slightly above the confluence, a confluence discharge is essentially into slack water. It is judged that special diffusion provisions should be provided and that additional dissolved oxygen be provided in the effluent to meet this slack water condition.

The Spokane River discharge point is selected for the representative system for Alternative NS-sw with secondary treatment with phosphorus removal at the point of concentration using the activated sludge process and alum coagulation. Reaeration would be provided before discharge to the river.

A subalternative is to locate the treatment facility at the confluence near the point of disposal rather than at the Fish Hatchery point of concentration. An advantage of the subalternative is that it would facilitate service to development west of the Fish Hatchery. The primary disadvantage is that it requires pumping and conveyance of raw sewage rather than treated effluent and would not permit interim disposal to the Little Spokane. It should not be necessary to make a detailed cost analysis of both in the early screening stages since the cost differences are small. Consideration of the subalternative is left for such time as the basic alternative proves to be a desirable candidate.

<u>Alternative (NS+SV)-sw</u>. The first subalternatives that must be considered for this system are the choice between combining the

flows in North Spokane or Spokane Valley. The problems of a surface water discharge near the North Spokane point of concentration are discussed above under alternative NS-sw. The natural point of concentration of the Spokane Valley is in the vicinity of the east end of Felts Field. A discharge to the Spokane River at this point would be upstream from the City of Spokane wells at Parkwater. Although this reach is normally one in which groundwater discharges to the river, there are times of high river flow when this condition is reversed. There is at high flow, therefore, the potential for contamination of the City wells. It is feasible to conduct the effluent downstream below Parkwater before discharging to the river. Therefore, a surface water discharge at either NS or SV requires an effluent extension from the respective point of concentration.

The transport problem between the two points of concentration involves a significant difference in pump lift. The choice of route is limited by topography and City developments. There is a feasible route along the east edge of the City that can be used for transport in either direction. The lift from the NS point of concentration to the intervening high point is approximately four times the lift from the SV point of concentration.

On the other hand, the Spokane Valley flows are approximately three times the North Spokane flow at 1980 and twice the North Spokane flow at year 2000. A substudy indicates that the larger pipe sizes required for SV flows more than offset the unfavorable lift relationship so that it is more cost effective to transport NS to SV.

Since the purpose of this initial screening is to rank systems on a cost effectiveness basis, the alternative of transporting the North Spokane flow to the Spokane Valley for combined treatment and surface water disposal is selected to represent (NS+SV)-sw. If this system element is among the favorable systems, then it is necessary to reopen this alternative choice to evaluate in terms of environmental consideration.

Alternative NS-li. Due to the relatively small flow from the North Spokane area as compared with the City, smaller candidate land areas can be considered for land application by irrigation. In addition to the alternative areas described above for alternative C-li, it is possible to consider nearby land in the Peone and Five Mile Prairies and the north bank of the Little Spokane River. Five Mile Prairie is eliminated because it is at an elevation of 2360 to 2400 feet, is scheduled for some low density residential development and has only enough area for disposal of part of the total annual flow. Land areas on the north bank of the Little Spokane River are in the form of steep canyons unsuited for agriculture. The only kind of irrigation feasible on such steep land would be forest irrigation at very low rates taking very large land areas in proportion to flow. The available lands are also at excessive elevations compared to Peone Prairie. Since Peone Prairie is nearer than any of the alternatives discussed under alternative C-li and more suitable than other local areas, it is selected as the application site for NS-li.

There are sites in the south edge of the Peone Prairie where

the required storage can be developed for seasonal effluent storage to utilize the total annual flow for irrigation.

Secondary treatment, the required pretreatment for irrigation application, could be achieved by three subalternatives: (1) Concentration facilities treatment at the point of concentration, (2) primary treatment at the point of concentration followed by lagoon treatment in the Peone Prairie or (3) complete lagoon treatment in the Peone Prairie.

Transport of raw sewage to Peone Prairie for full lagoon treatment, with first stage mechanical aeration, is selected as the lower cost subalternative representative for alternative NS-1i.

The subalternative of using irrigation for only seasonal disposal with surface water or infiltration as off season disposal is not compatible with full lagoon treatment at a location remote from alternative disposal opportunities.

The complete facilities for alternative NS-1i include:

1) Raw sewage pumping at point of concentration, comminution and standby power source for pumping.

2) Transmission mains from point of concentration to lagoon treatment.

3) Full lagoon treatment with mechanical aeration.

4) Repumping from lagoon treatment to seasonal storage.

5) Seasonal storage reservoir.

6) Irrigation distribution mains and pump station from storage to irrigated areas.

7) Crop sprinkler systems.

8) Groundwater quality monitoring.

The canyon through which Bruce Road passes is selected as a potential reservoir site. Subalternative sites are the next canyon east, Moffat Road, and the vicinity of Green Bluff on the north side of Peone Prairie.

Alternative (NS+SV)-li. The combination of North Spokane with Spokane Valley adds another irrigation area for consideration to those already discussed under alternative NS-li. This alternative area is the eastern part of the Spokane Valley. It would be possible to transport NS flows to the SV point of concentration as described for alternative (NS+SV)-sw. Although this alternative is technically feasible and possibly more cost effective than irrigation in Peone Prairie, it it not considered for the representative system for the same economic and groundwater quality reasons discussed under alternatives (C+NS+SV)-li.

The addition of SV flows to NS will strain the land availability in Peone Prairie but appears to be feasible. The representative plan can therefore be the same as developed for NS-li except for the larger flows involved and the addition of transport for the SV flows. The transport of the SV flows follows the same route described for (NS+SV)-sw development except that the SV flows are joined to the NS flows at the lagoon site in the vicinity of Mead rather than at the point of concentration of North Spokane. In addition to the facilities enumerated for NS-li, transport facilities for SV are required as follows:

1) Raw sewage pumping complete with comminution in the vicinity of Felts Field.

2) Transmission mains from Felts Field to the vicinity of Mead.

<u>Alternative NS-1p</u>. In addition to the infiltration-percolation sites described for City alternatives, it is technically possible to consider sites on the primary aquifer near the NS point of concentration. It should be recognized that the primary aquifer has a steep gradient in this area as it nears its discharge point in the Little Spokane River. Infiltration-percolation is essentially disposal to this groundwater stream, estimated at 200 cfs, which becomes a major flow component of the Little Spokane River flow below Dartford. Direct discharge to the surface flow in this reach has been eliminated above on the grounds of inadequate dilution. There is therefore, the possibility that this indirect discharge may be undesirable also on grounds of dilution unless higher level of treatment is provided. The degree of treatment possible by infiltration-percolation application of secondary effluent should be adequate for this consideration. Impact on groundwater quality is the limiting consideration and would require year around nitrogen removal as part of the treatment process. Since the land treatment by percolation will not provide adequate nitrogen removal, the nitrogen removal must be provided by the structural treatment process prior to land application. On the other hand the land treatment will provide adequate phosphorus removal so that structural treatment will not have to include phosphorus removal.

The approximate area required for infiltration-percolation at year 2000 flows for the NS service area is 55 acres, about 1500

feet square. This area, combined with that required for treatment, would be difficult to obtain in the vicinity of the point of concentration. It is assumed that the treatment facility and percolation area are located downstream in the vicinity of Rutter Parkway west of Indian Trails Road. This requires a pump station at the point of concentration and force main to the treatment and disposal site.

Alternative (NS+SV)-1p. Under discussion of alternative (NS+SV)-sw it was shown that the less costly transport to combine the two service areas is to convey NS flows to the Spokane Valley. Infiltration-percolation application is feasible at both locations. The potential impact on groundwater quality, is however, much greater in the Spokane Valley since there are major users downstream of the point of disposal. For this reason, an infiltration site near the downstream end of the primary aquifer as developed for NS alone is selected. This requires transport of the SV flows to NS in the reverse direction as that described for (NS+SV)-sw. Note that alternative (NS+SV)-sw provides a measure of the cost effectiveness of the NS to SV transport and, if this alternative should prove attractive, it would be reason to reconsider (NS+SV)-1p with percolation disposal in the Spokane Valley and its more severe potential for groundwater quality impact.

The treatment requirements and location are as described for NS-1p.

Spokane Valley Alternatives

All of the combination alternatives involving the Spokane

Valley have been described above as they occurred with the City and North Spokane. There remain to be discussed only those alternatives which involve the Spokane Valley alone, as follows:

SV-sw

SV-li

SV-lp

The natural point of concentration of the Spokane Valley service area lies in the northeast corner of Felts Field.

Alternative SV-sw. The nearest surface water disposal site is the Spokane River, adjacent to the natural point of concentration, but as pointed out in the (NS+SV)-sw alternative, the surface water disposal site is to be located below the City wells at Parkwater. Treatment will consist of secondary treatment plus alum coagulation to remove phosphorus. Effluent pumping will not be required; gravity flow will suffice. Reaeration, prior to discharge, will be provided.

Alternative SV-li. As with the NS-li alternative, the SV-li irrigation site is chosen as Peone Prairie. Irrigation in the Spokane Valley is ruled out due to adverse economic, environmental and social factors. Secondary treatment prior to reservoir storage is provided by aerated lagoon treatment at a site just east of the town of Mead. The list of facilities for treatment and disposal are:

1) Raw waste pumping at the point of concentration, including comminution and a standby power source.

2) Transmission mains from the point of concentration to lagoon treatment.

3) Full lagoon treatment with mechanical aeration.

4) Repumping from lagoon treatment to seasonal storage.

5) Seasonal storage reservoir.

6) Irrigation distribution mains and pump station from storage to irrigated areas.

7) Crop sprinkler system.

8) Groundwater quality monitoring.

Alternative SV-1p. The basic subalternatives to be considered are the possible locations of the percolation sites. Any place in the Spokane Valley, including at the SV point of concentration, is a physically feasible site due to the area wide distribution of the highly permeable materials. A percolation site upstream (in a groundwater flow sense) from the City wells is so similar in impact to the "do nothing" alternative that it is eliminated as a first choice for evaluation of this disposal concept. Immediately downstream from the City wells the existing development in the City precludes economically obtaining a percolation site of the required size, approximately 100 acres for typical intermittantly loaded operation. For these reasons, a site is sought with land availability and lesser potential impact on major groundwater use. The nearest site fitting these requirements is on the downstream surface of the primary aquifer north of the City in the vicinity of Mead. This site, although of lower potential groundwater impact is classified as discharge to an aquifer with unlimited access and requires full time nitrification-denitrification as part of the pretreatment process.

The complete facilities selected for evaluation of this alternative to utilize the above described land application site includes:

1) Secondary treatment plant at the SV point of concentration including full time nitrification-denitrification.

2) Pump station and conveyance force mains and sewers from the treatment plant to the vicinity of Mead via a route through the east edge of the City.

3) Infiltration-percolation ponds including distribution piping and control structures for intermittent loading.

4) Groundwater quality monitoring.

TABLE 1

POSSIBLE COMBINATIONS OF THE THREE BASIC SERVICE AREAS

System No.	Areas Handled in Combination	Areas Handled Separately
1		C, NS, SV
2	C+NS	SV
3	C+SV	NS
4	C+NS+SV	
5	NS+SV	C

Legend: C = City
NS = North Spokane
SV = Spokane Valley

TABLE 2

POSSIBLE COMBINATIONS OF
SERVICE AREA ENTITIES WITH DISPOSAL ALTERNATIVES

Service Entity	Disposal Alternative		
	Surface Water sw	Land Application Irrigation li	Land Application Percolation lp
C	C-sw	C-li	C-lp
NS	NS-sw	NS-li	NS-lp
SV	SV-sw	SV-li	SV-lp
C+NS	(C+NS)-sw	(C+NS)-li	(C+NS)-lp
C+SV	(C+SV)-sw	(C+SV)-li	(C+SV)-lp
C+NS+SV	(C+NS+SV)-sw	(C+NS+SV)-li	(C+NS+SV)-lp
NS+SV	(NS+SV)-sw	(NS+SV)-li	(NS+SV)-lp

Legend:
C = City
NS = North Spokane
SV = Spokane Valley
sw = surface water disposal
li = land application, irrigation
lp = land application, percolation

TABLE 3.1

POSSIBLE COMBINATIONS OF SERVICE AREA
AND DISPOSAL FOR URBAN PLAN SYSTEMS
IN WHICH ALL SERVICE AREAS ARE INDEPENDENT

System	Combination	System	Combination
1-1	C-sw, NS-sw, SV-sw	1-15	C-li, NS-li, SV-lp
1-2	C-sw, NS-sw, SV-li	1-16	C-li, NS-lp, SV-sw
1-3	C-sw, NS-sw, SV-lp	1-17	C-li, NS-lp, SV-li
1-4	C-sw, NS-li, SV-sw	1-18	C-li, NS-lp, SV-lp
1-5	C-sw, NS-li, SV-li	1-19	C-lp, NS-sw, SV-sw
1-6	C-sw, NS-li, SV-lp	1-20	C-lp, NS-li, SV-sw
1-7	C-sw, NS-lp, SV-sw	1-21	C-lp, NS-lp, SV-sw
1-8	C-sw, NS-lp, SV-li	1-22	C-lp, NS-sw, SV-li
1-9	C-sw, NS-lp, SV-lp	1-23	C-lp, NS-li, SV-li
1-10	C-li, NS-sw, SV-sw	1-24	C-lp, NS-lp, SV-li
1-11	C-li, NS-sw, SV-li	1-25	C-lp, NS-sw, SV-lp
1-12	C-li, NS-sw, SV-lp	1-26	C-lp, NS-li, SV-lp
1-13	C-li, NS-li, SV-sw	1-27	C-lp, NS-lp, SV-lp
1-14	C-li, NS-li, SV-li		

TABLE 3.2

POSSIBLE COMBINATIONS OF SERVICE AREA AND DISPOSAL
FOR URBAN PLAN SYSTEMS IN WHICH
CITY AND NORTH SPOKANE ARE COMBINED AND VALLEY IS SEPARATE

System	Combination
2-1	(C+NS)-sw, SV-sw
2-2	(C+NS)-sw, SV-1i
2-3	(C+NS)-sw, SV-1p
2-4	(C+NS)-1i, SV-sw
2-5	(C+NS)-1i, SV-1i
2-6	(C+NS)-1i, SV-1p
2-7	(C+NS)-1p, SV-sw
2-8	(C+NS)-1p, SV-1i
2-9	(C+NS)-1p, SV-1p

TABLE 3.3

POSSIBLE COMBINATIONS OF SERVICE AREA AND DISPOSAL
FOR URBAN PLAN SYSTEMS IN WHICH
CITY AND VALLEY ARE COMBINED AND NORTH SPOKANE IS INDEPENDENT

System	Combination
3-1	(C+SV)-sw, NS-sw
3-2	(C+SV)-sw, NS-li
3-3	(C+SV)-sw, NS-lp
3-4	(C+SV)-li, NS-sw
3-5	(C+SV)-li, NS-li
3-6	(C+SV)-li, NS-lp
3-7	(C+SV)-lp, NS-sw
3-8	(C+SV)-lp, NS-li
3-9	(C+SV)-lp, NS-lp

TABLE 3.4

POSSIBLE COMBINATIONS OF SERVICE AREA AND DISPOSAL FOR URBAN PLAN SYSTEMS IN WHICH CITY, NORTH SPOKANE AND VALLEY ARE COMBINED

System	Combination
4-1	(C+NS+SV)-sw
4-2	(C+NS+SV)-li
4-3	(C+NS+SV)-lp

TABLE 3.5

POSSIBLE COMBINATIONS OF SERVICE AREA AND DISPOSAL FOR URBAN PLAN SYSTEMS IN WHICH NORTH SPOKANE AND VALLEY ARE COMBINED AND CITY IS INDEPENDENT

System	Combination
5-1	(NS+SV)-sw, C-sw
5-2	(NS+SV)-sw, C-li
5-3	(NS+SV)-sw, C-lp
5-4	(NS+SV)-li, C-sw
5-5	(NS+SV)-li. C-li
5-6	(NS+SV)-li, C-lp
5-7	(NS+SV)-lp, C-sw
5-8	(NS+SV)-lp, C-li
5-9	(NS+SV)-lp, C-lp

TABLE 3.6

POSSIBLE COMBINATIONS OF SERVICE AREA AND DISPOSAL FOR URBAN SYSTEMS FROM WHICH SPOKANE VALLEY IS EXCLUDED

System	Combination
6-1	C-sw, NS-sw
6-2	C-sw, NS-li
6-3	C-sw, NS-lp
6-4	C-li, NS-sw
6-5	C-li, NS-li
6-6	C-li, NS-lp
6-7	C-lp, NS-sw
6-8	C-lp, NS-li
6-9	C-lp, NS-lp
6-10	(C+NS)-sw
6-11	(C+NS)-li
6-12	(C+NS)-lp

TABLE 4.1
DATA SUMMARY
SERVICE AREA COMBINATION ALTERNATIVES

Service Area: C : CITY (INCLUDING MORAN PRAIRIE & SOUTHWEST)

Population and Flow Forecast:

	1980	1985	1990	1995	2000	2020
Population	177,945	180,120	182,506	185,437	189,282	204,315
ADWF, mgd	30.026	31.354	32.386	33.367	34.250	36.855
PWWF, mgd *	53		56		59	64
Annual Ac. Ft.	33,624	35,111	36,266	37,365	38,354	41,271
Mean Monthly Ac. Ft.	2802.0	2925.9	3022.2	3113.8	3196.2	3439.2

Required Storage Volumes For Irrigation Application, Acre Feet

Winter Season (8 mo.)	22,416	23,407	24,177	24,910	25,569	27,514
Summer Surge (2 mo.)	5604	5852	6044	6228	6392	6878

Required Areas For Irrigation Application, Acres

Full Year Utilization

at 5.5 feet/yr.	6113	6384	6594	6799	6973	
at 3.7 feet/yr.	9088	9489	9802	10,099	10,366	

May-Sept. Utilization (5 mo.)

at 5.5 feet/yr.	2547	2660	2748	2831	2905	3127
at 3.7 feet/yr.	3787	3954	4084	4208	4319	4648

Required Areas for Infiltration-Percolation, Acres

at 180 feet/year	187	195	201	208	213	229
at 119 feet/year	283	295	305	314	322	347
at 83 feet/year	405	423	437	450	462	497

*Excluding urban runoff

TABLE 4.2
DATA SUMMARY
SERVICE AREA COMBINATION ALTERNATIVES

Service Area: NS : NORTH SPOKANE

Population and Flow Forecast:

	1980	1985	1990	1995	2000	2020
Population	17,220	19,818	29,443	36,080	44,627	62,482
ADWF, mgd	2.392	2.754	3.913	4.760	5.795	7.957
PWWF, mgd	6.291	7.129	9.763	11.619	13.887	18.358
Annual Ac. Ft.	2679	3084	4382	5330	6489	8910
Mean Monthly Ac. Ft.	223.2	257.0	365.2	444.2	540.8	742.5

Required Storage Volumes For Irrigation Application, Acre Feet

	1980	1985	1990	1995	2000	2020
Winter Season (8 mo.)	1786	2056	2921	3553	4326	5940
Summer Surge (2 mo.)	446	514	730	888	1082	1485

Required Areas For Irrigation Application, Acres

	1980	1985	1990	1995	2000	2020
Full Year Utilization						
at 5.5 feet/yr.	487	561	797	969	1180	1620
at 3.7 feet/yr.	724	834	1184	1441	1754	2408
May-Sept. Utilization (5 mo.)						
at 5.5 feet/yr.	203	234	332	404	492	675
at 3.7 feet/yr.	302	348	493	600	731	1003

Required Areas for Infiltration-Percolation, Acres

	1980	1985	1990	1995	2000	2020
at 180 feet/year	15	17	24	30	36	50
at 119 feet/year	23	26	37	45	55	75
at 83 feet/year	32	37	53	64	78	107

TABLE 4.3
DATA SUMMARY
SERVICE AREA COMBINATION ALTERNATIVES

Service Area: SV: SPOKANE VALLEY

Population and Flow Forecast:

	1980	1985	1990	1995	2000	2020
Population	52,227	57,737	63,166	69,154	74,061	91,021
ADWF, mgd	7.025	7.793	8.544	9.407	10.030	12.188
PWWF, mgd	16.631	18.103	19.807	21.295	22.716	27.068
Annual Ac. Ft.	7867	8727	9568	10,534	11,232	13,648
Mean Monthly Ac. Ft.	655.6	727.2	797.3	877.8	936.0	1137.4

Required Storage Volumes For Irrigation Application, Acre Feet

Winter Season (8 mo.)	5245	5818	6379	7023	7488	9099
Summer Surge (2 mo.)	1311	1454	1595	1756	1872	2275

Required Areas For Irrigation Application, Acres

Full Year Utilization

at 5.5 feet/yr.	1430	1587	1740	1915	2042	2481
at 3.7 feet/yr.	2126	2359	2586	2847	3036	3689

May-Sept. Utilization (5 mo.)

at 5.5 feet/yr.	596	661	725	798	851	1034
at 3.7 feet/yr.	886	983	1078	1186	1265	1537

Required Areas for Infiltration-Percolation, Acres

at 180 feet/year	44	48	53	59	62	76
at 119 feet/year	66	73	80	89	94	115
at 83 feet/year	95	105	115	127	135	164

TABLE 4.4
DATA SUMMARY
SERVICE AREA COMBINATION ALTERNATIVES

Service Area: C+NS: CITY (INCLUDING MP&SW) PLUS NORTH SPOKANE

Population and Flow Forecast:

	1980	1985	1990	1995	2000	2020
Population	195,165	199,938	211,949	221,517	233,909	266,797
ADWF, mgd	32.418	34.108	36.299	38.127	40.045	44.812
PWWF, mgd *	56		62		68	76
Annual Ac. Ft.	36,302	38,195	40,648	42,695	44,843	50,181
Mean Monthly Ac. Ft.	3025.2	3182.9	3387.4	3557.9	3736.9	4181.8

Required Storage Volumes For Irrigation Application, Acre Feet

Winter Season (8 mo.)	24,201	25,463	27,099	28,463	29,895	33,454
Summer Surge (2 mo.)	6050	6366	6776	7116	7474	8364

Required Areas For Irrigation Application, Acres

Full Year Utilization

at 5.5 feet/yr.	6600	6945	7391	7763	8153	9124
at 3.7 feet/yr.	9811	10,323	10,986	11,539	12,120	13,562

May-Sept. Utilization (5 mo.)

at 5.5 feet/yr.	2750	2894	3080	3235	3397	3802
at 3.7 feet/yr.	4088	4301	4578	4808	5050	5651

Required Areas for Infiltration-Percolation, Acres

at 180 feet/year	202	212	226	237	249	279
at 119 feet/year	305	321	342	359	377	422
at 83 feet/year	437	460	490	514	540	605

* Excluding urban runoff

TABLE 4.5
DATA SUMMARY
SERVICE AREA COMBINATION ALTERNATIVES

Service Area: C+SV: CITY (INCLUDING MP & SW) PLUS SPOKANE VALLEY

Population and Flow Forecast:

	1980	1985	1990	1995	2000	2020
Population	230,172	237,857	245,672	254,591	263,343	295,336
ADWF, mgd	37.051	39.147	40.930	42.774	44.280	49.043
PWWF, mgd *	63		70		75	83
Annual Ac. Ft.	41,490	43,838	45,834	47,899	49,586	54,919
Mean Monthly Ac. Ft.	3457.5	3653.1	3819.5	3991.6	4132.1	4576.6

Required Storage Volumes For Irrigation Application, Acre Feet

	1980	1985	1990	1995	2000	2020
Winter Season (8 mo.)	27,660	29,225	30,556	31,933	33,057	36,613
Summer Surge (2 mo.)	6915	7306	7639	7983	8264	9153

Required Areas For Irrigation Application, Acres

	1980	1985	1990	1995	2000	2020
Full Year Utilization						
at 5.5 feet/yr.	7544	7971	8333	8709	9016	9985
at 3.7 feet/yr.	11,214	11,848	12,388	12,946	13,402	14,843
May-Sept. Utilization (5 mo.)						
at 5.5 feet/yr.	3143	3321	3472	3629	3757	4160
at 3.7 feet/yr.	4672	4937	5162	5394	5584	6185

Required Areas for Infiltration-Percolation, Acres

	1980	1985	1990	1995	2000	2020
at 180 feet/year	230	244	255	266	275	305
at 119 feet/year	349	368	385	403	417	462
at 83 feet/year	500	528	552	577	597	662

* Excluding urban runoff

TABLE 46
DATA SUMMARY
SERVICE AREA COMBINATION ALTERNATIVES

Service Area: C+NS+SV: CITY (INCL. MP/SW) PLUS NORTH SPOKANE PLUS SPOKANE VALLEY

Population and Flow Forecast:

	1980	1985	1990	1995	2000	2020
Population	247,392	257,675	275,115	290,671	307,970	357,818
ADWF, mgd	39.443	41.901	44.843	47.534	50.075	57.000
PWWF, mgd *	67		76		85	97
Annual Ac. Ft.	44,169	46,922	50,216	53,230	56,075	63,830
Mean Monthly Ac. Ft.	3680.8	3910.1	4184.7	4435.8	4672.9	5319.1

Required Storage Volumes For Irrigation Application, Acre Feet

Winter Season (8 mo.)	29,446	31,281	33,477	35,487	37,383	42,553
Summer Surge (2 mo.)	7362	7820	8369	8872	9346	10,638

Required Net Areas For Irrigation Application, Acres

Full Year Utilization						
at 5.5 feet/yr.	8031	8531	9130	9678	10,195	11,605
at 3.7 feet/yr.	11,938	12,682	13,572	14,386	15,155	17,251
May-Sept. Utilization (5 mo.)						
at 5.5 feet/yr.	3346	3555	3804	4032	4248	4835
at 3.7 feet/yr.	4974	5284	5655	5994	6315	7188

Required Net Areas for Infiltration-Percolation, Acres

at 180 feet/year	245	261	279	296	312	355
at 119 feet/year	371	394	422	447	471	536
at 83 feet/year	532	565	605	641	676	769

* Excluding urban runoff

TABLE 47
DATA SUMMARY
SERVICE AREA COMBINATION ALTERNATIVES

Service Area: NS + SV: NORTH SPOKANE PLUS SPOKANE VALLEY

Population and Flow Forecast:

	1980	1985	1990	1995	2000	2020
Population	69,447	77,555	92,609	105,234	118,688	153,503
ADWF, mgd	9.417	10.547	12.457	14.167	15.825	20.145
PWWF, mgd	21.103	23.525	27.382	30.762	33.929	42.681
Annual Ac. Ft.	10,545	11,811	13,950	15,864	17,721	22,559
Mean Monthly Ac. Ft.	878.8	984.2	1162.5	1322.0	1476.8	1879.9

Required Storage Volumes For Irrigation Application, Acre Feet

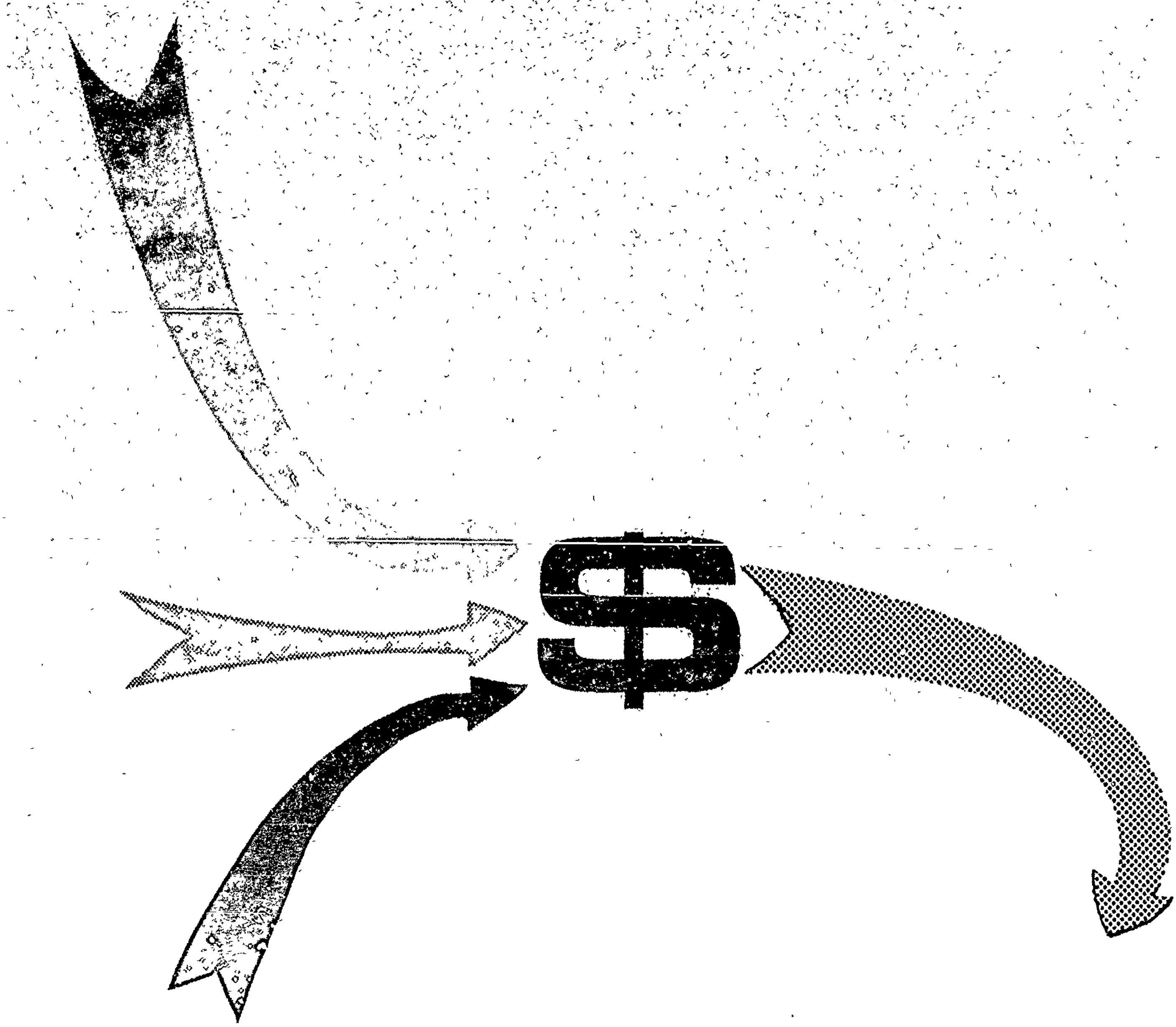
Winter Season (8 mo.)	7030	7874	9300	10,576	11,814	15,039
Summer Surge (2 mo.)	1758	1968	2325	2644	2954	3760

Required Areas For Irrigation Application, Acres

Full Year Utilization						
at 5.5 feet/yr.	1917	2147	2536	2884	3222	4102
at 3.7 feet/yr.	2850	3192	3770	4288	4789	6097
May-Sept. Utilization (5 mo.)						
at 5.5 feet/yr.	779	895	1057	1202	1342	1709
at 3.7 feet/yr.	1188	1330	1571	1787	1995	2540

Required Areas for Infiltration-Percolation, Acres

at 180 feet/year	57	66	78	88	98	125
at 119 feet/year	87	99	117	133	149	190
at 83 feet/year	127	142	168	191	214	272



SECTION 701.1

INITIAL COST-EFFECTIVENESS SCREENING OF WASTEWATER MANAGEMENT ALTERNATIVES

WATER RESOURCES STUDY

METROPOLITAN SPOKANE REGION

SECTION 701.1

INITIAL COST-EFFECTIVENESS SCREENING OF WASTEWATER MANAGEMENT ALTERNATIVES

8 August 1975

Department of the Army, Seattle District
Corps of Engineers
Kennedy-Tudor Consulting Engineers

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SECTION 701.1

INITIAL COST-EFFECTIVENESS SCREENING OF WASTEWATER MANAGEMENT ALTERNATIVES

Scope and Objectives

The objectives of this section are to summarize the cost-effective evaluations of the basic structural wastewater management alternatives and to rank the alternatives in order of increasing cost.

Net present worth of the sum of capital and operation and maintenance costs for a twenty year study period is computed for twenty-one elements composed of basic combinations of service area and ultimate disposal method as formulated in a previous section. The twenty-one elements are formulated based on physically feasible configurations which will meet various disposal criteria and are optimized for the particular combination and disposal alternative.

There are three basic considerations that are unresolved at this point in the study:

a. The need for seasonal versus year-round phosphorus removal for surface water disposal.

b. The need to collect domestic sewage in the Spokane Valley for centralized treatment and disposal.

c. The interpretation and timing of the national goal expressed in P.L. 92-500 for year 1985.

The latter undoubtedly will not be resolved before the completion of this study and the other two may well remain unresolved beyond the completion. Therefore, costs and rankings are performed considering

these potentially unresolved points as follows:

a. Costs and rankings are determined for both year-round and for seasonal phosphorus removal for all surface water alternatives for the condition that 1983 standards are in effect throughout the entire study period 1980 to 2000.

b. Costs are determined for alternatives both including and excluding Spokane Valley and rankings are assembled for systems that both include and exclude Spokane Valley.

c. In addition to the costs and ranking described above for the assumption of 1983 standards throughout the study period, costs and rankings are determined for the condition in which 1983 standards are in effect from 1980 to 1990 and interpreted 1985 standards are in effect from 1990 to 2000. Refer to the section on Disposal Criteria for details of the adopted interpretation of 1985 goals as future standards.

In addition to the coverage indicated above, certain other specific sub-alternatives are considered. One specific sub-alternative is the use of primary effluent for irrigation in lieu of secondary effluent. Another is seasonal disposal to land application for irrigation with that unneeded for irrigation going to surface water disposal. A third is the addition of complete nitrification-denitrification to the pretreatment requirements for percolation at the Downriver site.

For all evaluations, the same solids disposal alternative is applied throughout namely, anaerobic digestion, vacuum filtration and truck haul to sanitary landfill. An exception is made where lagoon treatment is used. Refinement of solids processing and disposal will follow selection of the basic wastewater management candidates.

A final objective of this section is to select from the cost-effectiveness ranked alternatives a smaller group of candidate alternatives which appear to be either leading contenders from a cost standpoint or

should be weighed against the lowest cost alternatives for their other qualities which cannot be set forth quantitatively in terms of cost. It is not the intent that this selection process be the result of a socio-environmental evaluation but rather a prelude to it.

Cost Criteria

The methodology for making the cost-effectiveness calculations and determining present worth of the capital cost and operation and maintenance cost components is as set forth in Section 401.1, Criteria for Cost Effectiveness Analysis.

Other significant costing criteria are as follows:

1. Costs of lands and rights-of-way are based on estimates of 1974 market value as determined by the County assessor.

2. Conveyance structures such as sewers and force mains are sized for year 2020 forecast flows and are constructed in a single stage. Prior substudies indicate no significant difference in present worth for staged construction in the increments needed for this study.

3. The City of Spokane sewage treatment plant with presently proposed improvements is assumed to be a sunk capital cost. Operation and maintenance costs are not regarded as sunk.

4. All required additions to the presently proposed improvements of the City STP and all other treatment facilities are sized for year 2000 flows.

5. Land application alternatives are priced on the assumption that all required lands will be purchased and owned by the wastewater management agency and that the net income, if any, from operation of the land will accrue to the agency.

6. Stage construction is utilized for treatment facility expansion and for land application installations.

7. Land purchased for reservoir storage includes an allowance for ultimate expansion to year 2020 needs. The dam is constructed to year 2000 needs.

8. Cost estimates for storage reservoirs are based on estimated earthwork volume for the specific sites selected.

9. Costs of internal sewerage within service areas, which are common to all alternatives except the Spokane Valley no action alternative, are not included.

Numerical Results

The cost effectiveness analysis is summarized in the accompanying tables as follows:

Table 1 shows the computed costs, as net present worth of the sum of capital and operation and maintenance costs for a study period of twenty years 1980 to 2000 of the 21 elements which make up the various systems which can serve the urban planning area. Costs are shown for 1983 standards, with seasonal and year-round phosphorus removal where applicable, and for interpreted 1985 standards imposed in 1990 for all alternatives and for certain special subalternatives.

Note that "1983 standards" do not preclude performance beyond the minimum. Therefore, both land application alternatives are listed under 1983 as well as under 1985 standards. The costs listed under 1983 standards are for the designated treatment and disposal system being in force from 1980 to 2000; that is, throughout the planning period. The costs shown under "1985 standards" are on the assumption that surface water disposal to 1983 standards would be utilized until 1990 at which time there would be an upgrading to interpreted 1985 standards using one of the three alternatives: swt = surface water disposal with

tertiary treatment, lp = infiltration-percolation, or li = land irrigation. For example; (C+NS)sw which indicates surface water disposal with secondary treatment for the entire 20 year planning period under 1983 standards shows a cost of 29.6 million dollars for year around P removal. Under 1985 standards, (C+NS)sw/swt indicates ten years of operation to 1990 with secondary treatment followed by addition of tertiary treatment and ten years of tertiary treatment operation with a total cost of 47.9 million dollars. Taking for another example (C+NS)lp under 1983 standards which indicates 20 years of operation with infiltration percolation disposal, which would more than meet 1983 standards but may be desirable for other reasons, at a cost of 50.3 million dollars. Under 1985 standards, (C+NS)sw/lp indicates 10 years of operation with secondary treatment and surface water disposal then upgrading to infiltration-percolation disposal in 1990 for operation in that mode thereafter for a total cost of 35.2 million dollars. Note that the second cost is lower than the first reflecting the early years operation at minimum standards. This is not an anomolous result but rather the result of two different bases for comparison. The basis under "1983 standards" shows what the cost comparison is if there is no need to upgrade before the end of the planning period. Under "1985 standards" is shown the consequences of assuming that the lowest cost method is used until 1990 at which time there is a compulsory upgrading. This distinction exists not only in Table 1 but in Tables 2 through 7 which are derived from Table 1.

In Tables 2 through 7, the various system elements are combined in the various alternative ways developed in Section 604.2. The

column headed system refers to the system designations developed in Tables 3.1 through 3.6 in Section 604.2.

Table 2 ranks 57 system alternatives, which include Spokane Valley, for the condition of 1983 standards being in effect throughout the entire study period, 1980 to 2000, and for the seasonal phosphorus removal where disposal is to surface water.

Table 3 ranks 12 system alternatives which do not include Spokane Valley for the condition of 1983 standards in effect 1980-2000 and for seasonal phosphorus removal to surface water disposal.

Table 4 ranks 57 system alternatives including Spokane Valley for 1983 standards, for year around phosphorus removal.

Table 5 ranks 12 system alternatives excluding Spokane Valley for 1983 standards, for year-round phosphorus removal.

Table 6 ranks 57 alternative systems including Spokane Valley, for the condition of 1983 standards and surface water disposal in force 1980 to 1990 and with interpreted 1985 standards in force 1990 to 2000 applying alternative disposal systems.

Table 7 ranks 12 alternative systems excluding Spokane Valley for same conditions as Table 6.

Interpretation of Numerical Results

If 1983 standards hold to year 2000, surface water disposal is least costly whether phosphorus removal is required to be seasonal or year-round. Seasonal versus year-round phosphorus removal makes no difference in ranking for the entire 12 systems where Spokane Valley (SV) is not included and makes only inconsequential differences throughout the 57 alternatives where SV is included.

The first City (C) involved alternatives other than surface water (sw) disposal which appears in ranking is (C+NS) 1p ranked 15th in year-round phosphorus removal and 17th in seasonal phosphorus. At this point in the ranking order, the overall system costs are 50% above the lower cost sw alternatives.

The first City alternative involving land application to irrigation (li) does not occur until rank 41 for both year-round and seasonal phosphorus removal. At this ranking level, system costs are twice the level of the lower cost sw alternatives.

There is a distinct cost advantage in combining NS with the City regardless of the ultimate kind of disposal.

There is no cost advantage in combining City and SV for surface disposal, the least costly alternative for SV going alone is sw.

There is a small advantage to combining NS and SV to surface disposal, considering these elements alone but this does not lead to the lowest cost overall systems. There is likewise an advantage to combining NS and SV for li if that should be desireable for environmental reasons.

In summary, from a cost standpoint, if 1983 standards hold, the most cost effective system is (C+NS)sw with SV-sw by a significant margin for both seasonal and year-round phosphorus removal. This system is also compatible with the consideration of when and whether the Spokane Valley should be sewered.

If more severe surface water disposal criteria are imposed, corresponding to interpreted standards to meet the 1985 goal of P.L. 92-500, the cost effective ranking is found to be significantly different than that based solely on 1983 disposal criteria. As shown in the section on disposal criteria, the assumption is made that these more severe standards are not likely to be imposed until 1990. To continue the comparison based on a study period from 1980 to 2000, it is possible to consider two

alternative programs where land application is involved, one being to assume that the land application techniques are used throughout the entire study period and the other to assume that surface water disposal would be used as an interim method to 1990 at which time a change would be made to land application. The latter program is feasible since the existing City STP, which is adequate for surface water disposal under 1983 criteria, also serves as the pretreatment facility for all land application alternatives involving City flows.

The interpreted 1985 standards for surface water disposal are expressed in terms of treatment methodology as being equal to the addition to secondary treatment of complete nitrification-denitrification, multi-media filtration, carbon adsorption and ozone disinfection. In the following discussion, this added treatment is designated tertiary treatment.

The element costs shown in Table 1 under the heading 1985 standards are developed for the assumption that surface water disposal with treatment to 1983 standards is used for all City involved alternatives from 1980 to 1990 and that from 1990 to 2000, interpreted 1985 standards are met alternatively by going to tertiary treatment prior to surface water disposal or continuing secondary as pretreatment for land application.

Referring to Tables 6 and 7 for ranking of systems composed of element costs per 1985 standards from Table 1, it is seen that systems in which land application to rapid percolation (lp) are adopted in 1990 are the more cost effective. Surface water disposal with tertiary treatment ranks next and land application to irrigation ranks last. The service

area combination of City plus NS with SV separate remains as the favored alternative as found for 1983 standards.

If it is desireable to consider the ranking positions for the assumption that land application alternatives are utilized for the entire study period rather than delayed until 1990, Table 1 shows these element costs under 1983 standards. This demonstrates the cost premium for land application in the 1980 to 1990 period where that treatment is not required by discharge standards.

The basic costing for all City involving rapid percolation (lp) alternatives assumes that nitrification-denitrification is not a prerequisite for disposal at the Downriver site. There is a possibility that this may not be acceptable. Therefore, a special alternative costing is made to determine if the addition of nitrification-denitrification would affect the ranking. The result is shown in Table 1 Note (6) special cost for the element (C+NS)-sw/lp. The resultant increase in cost is not sufficient to change the ranking of lp alternatives relative to sw or li.

Also shown in Table 1 is a special costing for the subalternative in which primary treatment is substituted for secondary treatment as the pretreatment prior to land application to irrigation (li). Substitution of primary treatment for secondary land application by irrigation does not significantly change the ranking of li alternatives since it affects only the operation cost of treatment, the capital cost of secondary being already covered as a sunk cost for City involved alternatives. It should be noted, however, that even if the secondary facilities were not

a sunk capital cost, the 11 alternatives for City involved systems would still remain the more costly by a significant margin.

A final special subalternative shown in Table 1 provides information on land application to irrigation for the City in which only the summer flow is so disposed and the winter flow is released to surface water discharge. The lesser land area required permits consideration of a nearby area in the vicinity of Airways Heights, that would not be large enough for full year flows. This seasonal approach is feasible if year-round phosphorus removal is not required and more severe surface water standards per 1985 goals are not imposed. This alternative is significantly lower cost than the full year alternative but remains more costly than either surface water disposal or rapid percolation.

Conclusions Based on Cost Effectiveness

The lowest cost system for as long as 1983 standards are in force is surface water disposal with the City and North Spokane combined to the existing City STP and with Spokane Valley being treated and disposed separately. This result holds whether the requirement for phosphorus removal is seasonal or year-round. This alternative is likewise compatible with the most cost effective systems when and if more stringent standards are imposed and is compatible with the need to be flexible with regard to Spokane Valley.

If more stringent surface water disposal criteria are imposed, surface water disposal is no longer the most cost effective alternative. The most cost effective alternative for City combinations is land application

to percolation. All of the major facilities previously needed for surface water disposal are still required and the facilities for land application are all additive. Continuation of surface water disposal by increasing the level of treatment to satisfy interpreted 1985 standards is more costly than going to percolation disposal, even if complete nitrification and denitrification are made a pretreatment requirement at the Downriver site. Land application by irrigation of the total annual flow is more costly than either advanced treatment for surface water disposal or percolation with or without nitrification-denitrification.

Therefore, from a cost standpoint alone, the selection of an initial system for surface water disposal, combining the City and North Spokane to the existing City plant, would provide a flexible basis for either continuation or conversion to land application by percolation at a later date. The size of the percolation site required and the limited availability of suitable land within economical conveyance distance indicates the need to acquire the percolation site now or preserve its availability through zoning.

To go to other than surface water for City involved alternatives prior to a requirement to meet disposal criteria more strict than 1983 involves significantly greater costs which must be weighed against any net non-monetary advantages. The added cost to go to land application by percolation is of the order 20 million dollars and to go to land application by irrigation is of the order 70 million dollars. That is, there would be a very high price tag on any such non-monetary advantages.

For Spokane Valley, the cost effective choice is surface water disposal until such time as criteria is more stringent than 1983 are imposed. The advantage over land application is large, being of the order of 12 to 14 million dollars. With the imposition of interpreted 1985 standards, the cost favored alternative for Spokane Valley becomes rapid percolation despite the criteria for full nitrification-denitrification used in this case. This lends itself to a stepwise approach as in the case of City alternatives by utilizing surface water disposal as the initial phase and in 1990 increasing treatment to include nitrification-denitrification and providing for land application to rapid infiltration. Irrigation remains more costly either initially using lagoon treatment or stepwise using concentrated site treatment for surface water disposal and converting to irrigation at 1990.

The "no action" alternative for Spokane Valley which means continuing with individual on-site disposal is the lowest cost, of course, since the existing individual facilities are a sunk cost and the forecast growth percentage wise is relatively small. A cost is not developed for this alternative at this point.

Selection of Candidates for Continuing Analysis

Cost effectiveness is not the primary or sole basis for plan selection. Therefore, no candidate plan can be eliminated for cost reasons alone any more than can one plan be selected for cost reasons alone. The primary function of cost ranking is to provide a means of evaluating plans selected for the degree to which social, economic, and environmental goals are met. The objective at this point is, therefore,

to select the more cost effective plans which will achieve the primary social, economic, and environmental goals so that they may be further analyzed for their ranking in meeting a broad spectrum of social, economic, and environmental criteria. In this iterative process, it can be expected that results of the detailed ranking may cause a return to the complete list for candidates passed over at this time which may be found to offer compromise or subalternative opportunities not now apparent or which may appear desireable even at higher cost.

The following listing is selected to embody the overall primary social, economic, and environmental goals to be met. At least one alternative plan that appears strongly responsive to each of these goals is selected for further detailed analysis:

(1) Minimize regional cost

(2) Maximize protection of surface waters from pollution

(3) Maximize protection of ground waters from pollution

(4) Maximize water reclamation and reuse

(5) Minimize disruption of natural habitat or enhance natural habitual restoration.

(6) Minimize displacement of people from their homes or employment

(7) Minimize disruption of land use patterns

(8) Minimize energy consumption

(9) Possess maximum potential for achieving the 1985 goal of "no pollution"

A thorough canvass of the system alternatives in cost-effectiveness. ranked order against the goals listed above results in the selection of

seven alternatives which appear to most effectively meet one or more of these goals and also include at least one alternative that is most qualified to meet each goal. The selected candidate alternatives are displayed in Table 8 in a matrix with the list of social, economic and environmental goals. The matrix is filled in with a brief statement showing how each alternative qualifies relative to each goal. An asterisk indicates the alternative plan or plans which appear to best meet each particular goal. These asterisks are not intended to indicate unqualified meeting of a goal but rather a comparatively high degree of satisfaction. General considerations to select representative system also impact upon the detailed conditions listed above and summarized in Table 8. These considerations are briefly discussed below:

(C+NS)sw, SVsw, designated Plan A, is selected for its least cost position and as representative of traditional surface water disposal.

C-sw, NS-1i, SV-sw, designated Plan B, is selected as an example of an institutionally independent system wherein each service area provides its own facilities plus including the application of irrigation disposal to the NS element where the cost penalty for irrigation is lowest.

(C+NS+SV)sw, designated Plan C, is selected because it is the lowest cost representative of a single system regional plan.

(C+NS)-sw/1p, SV-sw/1p, designated Plan D, is selected because it is the lowest cost method of upgrading to 1985 standards of the plan which is lowest cost under 1983 standards, Plan A. This system also provides representation of the infiltration-percolation disposal

technique. Note that Plan D is not strictly speaking an alternative to Plan A but rather represents a feasible upgrade of Plan A.

(C+NS)li-sw, SV-li, designated Plan E, is selected as the lowest cost representative of land application for the entire service area. It should be noted that this plan also represents the system of seasonal land application with surface water disposal as the off-season method.

(C+NS)li, SV-li, designated Plan F, is selected to represent total land application of all wastewater flows from all service areas. This system represents complete reclamation for irrigation use and full time compliance with interpreted 1985 standards.

(NS+SV)li, C sw/lp, designated Plan G, is selected to represent those systems which combine County area, with the City separate. A system with land application from the start for NS+SV is selected and combined with a City system starting with surface disposal and then being upgraded to interpreted 1985 standards. This system is also selected for its better cost position relative to Plan D than offered by Plans E or F.

C-sw, NS-sw, SV-sw, designated Plan H, is selected to represent the condition described for North Spokane in the present County Adopted Plan.

Each of the selected alternatives is shown schematically on Plates 604.3-1 through 8. To simplify identification of this smaller group of candidate plans, a simple single identifying letter is introduced above to supplement the more complex identifiers used to

formulate the full list of alternatives. These selected plans and a brief description are summarized below and detailed descriptions are provided on the following pages.

Note that the total "No Action" alternative is included in the selected candidate plans for further consideration. Partial "No Action" plans are implicit in all alternatives which consider Spokane Valley separately.

SUMMARY OF SELECTED CANDIDATE PLANS

Plan Identifier	Symbol	Description
A	(C+NS)-sw, SV-sw	Surface water disposal, City and North Spokane combined, Spokane Valley separate.
B	C-sw, NS-li, SV-sw	Separate disposal for all service areas, City to surface water, North Spokane to irrigation, Spokane Valley to surface water.
C	(C+NS+SV)-sw	All service areas combined to surface water disposal.
D	(C+NS)sw/lp, SV-sw/lp	City and North Spokane combined to initial surface water disposal converted to rapid percolation at 1990; Spokane Valley separate to initial surface water disposal converted to rapid percolation in 1990.
E	(C+NS)-li-sw, SV-li	City and North Spokane combined to summer season irrigation and winter surface water disposal; Spokane Valley separate to irrigation.
F	(C+NS)-li, SV-li	City and North Spokane combined to irrigation; Spokane Valley separate to irrigation.
G	(NS+SV)li, C sw/lp	North Spokane and Spokane Valley combined to irrigation, City separate, initially to surface water phased to rapid percolation in 1990.
H	C-sw, NS-sw, SV-sw	Separate disposal for all service areas to surface water.
I	No Action	City to surface water disposal utilizing committed upgraded STP; North Spokane and Spokane Valley to continue with individual and small group on-site disposal systems.

Description of Candidate Plans

PLAN A proposes surface water disposal throughout the entire planning period, 1980 to 2000, with treatment to 1983 standards. The combined flows from the City and North Spokane are treated in the upgraded City plant for disposal to the Spokane River at that point. The Spokane Valley would be sewered to a separate treatment plant located near the east end of Felts Field and the treated effluent is piped downstream approximately 2 miles for discharge to the Spokane River downstream from the City wells.

North Spokane would be sewered to a natural point of concentration in the vicinity of the Fish Hatchery from which it is pumped to the City treatment plant site, a distance of approximately 8.8 miles. The conveyance route is west and south around Five Mile Prairie and involves a total lift of 425 feet provided by two lift stations.* The developed areas west of Five Mile Prairie are added to the force main by a separate lift station. Since raw sewage is being conveyed, the pump stations include standby power and pumping capacity to insure operation at all times.

The City of Spokane service area is basically sewered to the present treatment site and future growth, including areas designated Moran Prairie and Southwest, would be added to the basic collection system.

The proposed improvement and expansion of the City STP to a 40 mgd secondary facility utilizing an activated sludge process with provision for chemical removal of phosphorus would have adequate

*Subsequent studies indicate a superior functional system using a route through the City via Francis Avenue. See Section 704.1.

capacity for the combined City and North Spokane service areas to year 2000. No basic addition to the City facility is included except minor modification to permit a degree of seasonal nitrification. Disposal would be to the Spokane River adjacent to the plant at river mile 67.2.

The treatment plant for the Spokane Valley consists of an activated sludge secondary treatment plant in one stage of construction. Chemical removal of phosphorus is included. Disposal would be to the Spokane River by submerged outfall at river mile 79.0.

PLAN B proposes separate treatment and disposal for the three main service areas; the City to surface water, North Spokane to irrigation and Spokane Valley to surface water. Standards for treatment prior to surface water disposal use 1983 standards throughout the planning period 1980 to 2000.

The City of Spokane, including the addition of only Moran Prairie and Southwest, utilizes the proposed improved and expanded City STP for disposal to the Spokane River at the plant site. The planned expansion to 40 mgd provides capacity for forecast City flows to beyond the year 2020. The proposed upgrade to activated sludge secondary with chemical phosphorus removal requires no basic addition or modification except a minor one to permit seasonal nitrification.

North Spokane would be sewered to the natural point of concentration in the vicinity of the Fish Hatchery. Flows from developed areas west of Five Mile Prairie are conveyed to the Fish Hatchery area after 1990 by a combination of force main and gravity sewer approximately 4.7 miles long; one pump lift of 314 feet is required. From the

point of concentration at the Fish Hatchery, raw sewage is conveyed approximately 6.1 miles to a lagoon-type treatment facility located in Peone Prairie utilizing one pump lift of 298 feet. The treatment facility is a multi-cell lagoon system with mechanical aeration to produce an effluent comparable to secondary treatment. The lagoons would occupy a site of 179 acres and are constructed in three stages to year 2000 capacity of 5.8 mgd.

A storage reservoir of 5,700 acre feet gross capacity would be provided by construction of an earthfill dam in the mouth of Bruce Canyon(1). The storage reservoir is sized to store treated wastewater flow during the non-irrigation season for subsequent use during the irrigation season. A pump lift of 113 feet and conveyance distance of approximately 2 miles is required from the lagoon site to the storage reservoir.

Agricultural lands for irrigation application of stored treated wastewaters are required totaling 2017 acres at year 2000. The required irrigation plant includes (1) conveyance from Bruce Canyon Reservoir to and throughout the irrigation area, (2) disinfection facilities, (3) pumping facilities and (4) solid set sprinkler irrigation facilities.

The Spokane Valley would be sewered to its natural point of concentration in the vicinity of the east end of Felts Field. A

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(1) Initial cost effective analysis does not include the cost of highway or utility relocation and does not include compensation above land cost for resident relocations.

secondary treatment plant of 10 mgd capacity would be constructed in one stage to serve year 2000 requirements. The treatment plant is an activated sludge plant with chemical phosphorus removal. The secondary treated effluent would be conveyed approximately 2 miles downstream for surface water discharge to the Spokane River at a point below the City wells.

PLAN C proposes to combine all service areas to surface water disposal with treatment at a single site, the existing City treatment plant site. The treatment provided is to 1983 standards throughout the planning period 1980 to 2000. North Spokane would be sewered to a natural point of concentration in the vicinity of the Fish Hatchery from which flow would be pumped to the City treatment plant site, a distance of approximately 8.8 miles. The conveyance route is west and south around Five Mile Prairie and involves a total life of 425 feet provided by two lift stations. The developed areas west of Five Mile Prairie are added to the force main by a separate lift station. Since raw sewage is being conveyed, the pump stations would include standby power and pumping capacity to insure operation at all times.

Spokane Valley would be sewered to its natural point of concentration in the vicinity of the east end of Felts Field. Conveyance would be provided for the raw sanitary wastes from the point of concentration to the City STP site involving approximately 9.2 miles of

force main and sewer with required static lift of less than 50 feet. The route is largely in city streets; paralleling the railroad which bounds the south edge of Felts Field thence following Mission Street from the eastern city limit west across the river, offsetting north at Ruby Street to Indiana, continuing west on Indiana to Northwest Boulevard which provides direct access to the City STP site. Raw sewage pumping stations are provided with standby power and pumping capacity to insure operation at all times.

The proposed enlargement and upgrading of the City STP would provide secondary treatment with chemical phosphorus removal for flows to 40 mgd. The combined flows of the City, North Spokane and Spokane Valley service areas are forecast to exceed this in 1981. The proposed enlargement and upgrading is planned for further capacity expansion in a 20 mgd increment which would bring total plant capacity to 60 mgd. The proposed incremental enlargement of 20 mgd is scheduled in this plan for year 1980 to meet combined service area requirements. The resultant 60 mgd capacity is adequate to meet forecast requirements for the combined service areas to year 2020. The proposed 1980 increment also provides minor modification to include a degree of seasonal nitrification.

PLAN D proposes combining City and North Spokane to initial surface water disposal phased into rapid percolation disposal in 1990 with Spokane Valley separately, but in similar manner, to have initial surface water disposal phased to rapid percolation in 1990. The surface water disposal is to 1983 standards and the shift to rapid perco-

APPENDIX IVs
ELEMENT COST SUMMARY, 1985 STD.

Alternative: (NS+SV)-sw Subalternative: ____

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	5,963,000	640,000	6,603,000
Service Area Conveyance, Land	8,000		8,000.
Treatment Facilities, Const.	14,891,000	9,640,000	24,531,000
Treatment Facilities, Land	57,000		57,000
Disposal Conveyance, Const.	2,068,000	86,000	2,154,000
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	22,922,000	10,366,000	33,288,000
Subtotal w/o solids, land	65,000		65,000
Total w/o solids	22,987,000	10,366,000	33,353,000
Solids Facilities, Const.	2,225,000	2,417,000	4,642,000
Solids Facilities, Land	45,000		45,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	25,147,000	12,783,000	37,930,000
SUBTOTAL incl. solids, LAND	110,000		110,000
TOTAL incl. solids	25,257,000	12,783,000	38,040,000

Notes:

in the vicinity of Mead on the downstream end of the primary aquifer. The location minimizes the area from which affected groundwater may be drawn but is nevertheless classified as a site of unrestricted access requiring pretreatment for nitrate reduction. The required area for the forecast flow to year 2000 is 118 acres. The infiltration ponds are constructed as multicellular with piping and control structures for intermittant cycling. Pond construction is in one stage.

The required conveyance from the Spokane Valley treatment facility to the percolation site will have been partially constructed in the first phase as an element of the conveyance downstream for surface water disposal. The additional conveyance structures begin at the end of the preexisting surface water discharge at the east city limit. The route continues westward and turns north to cross the river at Greene Street, thence north through the eastern edge of the City. The total added length is approximately 8.2 miles and includes a static lift of 137 feet.

The 10 mgd Spokane Valley Treatment plant, built as an activated sludge secondary plant with chemical phosphorus removal would be modified in 1990 with the advent of percolation disposal to drop the operation of chemical phosphorus removal but complete nitrification-denitrification facilities would be added.

PLAN E proposes combining City and North Spokane service areas to a split disposal system of summer flow to irrigation and winter flow to surface water and with Spokane Valley separately to full time irrigation disposal.

The facilities to combine the City and North Spokane for surface water disposal utilizing the upgraded and expanded City STP are as described for the corresponding part of Plan A. In summary these facilities are: approximately 8.8 miles of conveyance structures, including pumping facilities for a lift of 425 feet to join North Spokane to the City and the proposed City STP improvement to activated sludge secondary treatment with a capacity of 40 mgd.

The facilities to provide irrigation disposal to the wastewater flow concurrent with the April through September irrigation season consist of conveyance structures, storage and irrigation distribution and sprinkler systems. The site selected for irrigation is immediately north of Airways Heights. The required land area for irrigation with forecast flows to the year 2000 is 10,700 acres. The site selected for storage is the canyon through which Old Trails Road[1] enters Riverside State Park from the south. A reservoir with 7700 acre feet storage would be created in this canyon by construction of a combination rock fill and earth dam. The reservoir is sized only for the purpose of equalizing wastewater flows with irrigation demand. The capacity would be inadequate to store winter flows for summer irrigation.

Conveyance from the City STP to the Old Trails reservoir site consists of approximately 3 miles of force main, including a river crossing, and a static pump lift of 516 feet.

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(1) The initial cost effectiveness estimates do not include the costs of road, railroad or utility relocations at this site.

Irrigation facilities consist of conveyance from Old Trails reservoir to and throughout the irrigated area, pumping and disinfection equipment and solid set sprinkler systems.

The area selected for disposal of Spokane Valley wastewaters by irrigation is in the Peone Prairie. Pretreatment which would utilize a lagoon secondary treatment system is selected, also located in the Peone Prairie. The Bruce Canyon site is selected for storage of treated wastewater.

Conveyance requirements are from the natural point of concentration of the Spokane Valley near the east end of Felts Field to the lagoon treatment site in Peone Prairie and from the lagoons to the Bruce Canyon reservoir. Conveyance of raw sewage from the Spokane Valley to the lagoon site includes approximately 10.7 miles of force mains and gravity sewers and a static pump lift of 137 feet. The route is westward along the southerly boundary of Felts Field and into the City to cross the river at Greene Street, thence northerly through the east edge of the City into open country northeast of the City. Conveyance from the lagoons to Bruce Canyon reservoir consists of approximately 2 miles of force main and a lift of 130 feet.

The lagoon treatment system is a multicell system with mechanical aeration to produce an effluent comparable to secondary treatment. The lagoons occupy a site of 308 acres and are constructed in two stages to year 2000 capacity of 10 mgd.

The storage reservoir is sized at 8,900 acre feet for storage to carry over winter wastewater for subsequent use in the irrigation

season. The reservoir is created by an earthfill dam at the mouth of Bruce Canyon.[1]

The required area of irrigated lands would be 3500 acres to serve at the year 2000. Irrigation facilities include piping from the Bruce Canyon reservoir to and throughout the irrigated area and solid set sprinkler facilities. Disinfection and supplementary pumping are provided between the reservoir and irrigation.

PLAN F proposes combining City and North Spokane service areas to treatment and irrigation disposal with Spokane Valley having separate treatment and irrigation disposal. The entire year's wastewater flow is disposed of to irrigation under this plan through provision of storage for carryover between irrigation seasons.

The facilities to combine the City and North Spokane to provide pretreatment before irrigation disposal are the conveyance structures and the upgraded and expanded City STP as described for the corresponding part of Plan A. In summary these facilities are: approximately 8.8 miles of conveyance structures, including pumping facilities for a lift of 425 feet to join North Spokane to the City STP, and the proposed City STP improvement to activated sludge secondary with a capacity of 40 mgd.

The site selected for irrigation utilizing the combined year around City and North Spokane wastewater flows is the Williams Valley

(1) Initial cost effectiveness analysis does not include the cost of highway or utility relocation and does not include compensation above land cost for resident relocations.

southwest of Deer Park. The site selected for carryover storage is the canyon at the south edge of Williams Valley in which Prufer Road intersects Mullenx Road.

The conveyance structures to join the existing City STP to the Prufer Road Reservoir Site consist of approximately 20 miles of force mains and sewers including pumped lifts totaling 536 feet. Equalizing storage is included to reduce peak conveyance flows.

Prufer Reservoir is sized at 31,700 acre feet to provide carryover storage of combined flows to the forecast level of year 2000. Prufer Reservoir is created by an earthfill dam across the mouth of the valley with a crest length of 4700 feet and a height of 98 feet.

The land area required for irrigation application of the full year wastewater flow of the combined City and North Spokane service areas is 13,900 acres. Irrigation facilities include piping from the reservoir into and throughout the irrigated area. Also included are disinfection and supplementary pumping for flows leaving the reservoir.

The facilities for Spokane Valley treatment and disposal are identical with the corresponding component of Plan E, repeated here as follows:

The area selected for disposal of Spokane Valley wastewaters by irrigation is in the Peone Prairie. Pretreatment which would utilize a lagoon secondary treatment system is selected, also located in the Peone Prairie. The Bruce Canyon site is selected for storage of treated wastewater.

Conveyance requirements are from the natural point of con-

centration of the Spokane Valley near the east end of Felts Field to the lagoon treatment site in Peone Prairie and from the lagoons to the Bruce Canyon reservoir. Conveyance of raw sewage from the Spokane Valley to the lagoon site includes approximately 10.7 miles of force mains and gravity sewers and a static pump lift of 13.7 feet. The route is westward along the southern boundary of Felts Field and into the City to cross the river at Greene Street, thence northerly through the east edge of the City into open country northeast of the City. Conveyance from the lagoons to Bruce Canyon reservoir consists of approximately 2 miles of force main and a lift of 130 feet.

The lagoon treatment system is a multicell system with mechanical aeration to produce an effluent comparable to secondary treatment. The lagoons occupy a site of 308 acres and are constructed in two stages to year 2000 capacity of 10 mgd.

The storage reservoir is sized at 8,900 acre feet for storage to carry over winter wastewater for subsequent use in the irrigation season. The reservoir is created by an earthfill dam at the mouth of Bruce Canyon.[1]

The required area of irrigated lands would be 3500 acres to serve at the year 2000. Irrigation facilities include piping from the Bruce Canyon reservoir to and throughout the irrigated area and solid set sprinkler facilities. Disinfection and supplementary pumping are

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(1) Initial cost effectiveness analysis does not include the cost of highway or utility relocation and does not include compensation above land cost for resident relocations.

provided between the reservoir and irrigation.

PLAN G proposes combining the North Spokane and Spokane Valley service areas to treatment and disposal by land irrigation with the City separately and would utilize surface water disposal to 1990 and high rate percolation disposal after 1990.

The sites chosen for lagoon treatment, storage and irrigation for the combined North Spokane and Spokane Valley service areas are in Peone Prairie as previously selected in Plans B, E and F for these service areas separately. Irrigation disposal is for the entire year's wastewater flows, utilizing carryover storage for the non-irrigation season.

Conveyance requirements for North Spokane are from its natural point of concentration in the vicinity of the Fish Hatchery to the lagoon treatment site. In addition, flows from developed areas west of Five Mile Prairie would be conveyed to the Fish Hatchery area after 1990 by a combination of force main and gravity sewer approximately 4.7 miles long; one pump lift of 314 feet is required. From the point of concentration at the Fish Hatchery, raw sewage is conveyed approximately 6.1 miles with a lift of 298 feet to the lagoon site.

Conveyance requirements for the Spokane Valley are from the natural point of concentration near the east end of Felts Field to the lagoon treatment site in Peone Prairie. Conveyance of raw sewage from the Spokane Valley to the lagoon site includes approximately 10.7 miles of force mains and gravity sewers and a static pump lift of 137 feet. The route is westward along the southerly boundary of Felts Field and

into the City to cross the river at Greene Street, thence northerly through the east edge of the City into open country northeast of the City.

Conveyance from the lagoons to Bruce Canyon reservoir would require approximately 2 miles of force main and a lift of 130 feet. The lagoon treatment system is multicell system with mechanical aeration to produce an effluent comparable to secondary treatment. The lagoons occupy a site of 490 acres and would be constructed in two stages to year 2000 capacity of 15.9 mgd.

The storage reservoir is sized at 12,000 acre feet for storage to carry over winter wastewater for subsequent use in the irrigation season. The reservoir is created by an earthfill dam at the mouth of Bruce Canyon.(1)

The required area of irrigated lands would be 5500 acres to serve at the year 2000. Irrigation facilities include piping from the Bruce Canyon reservoir to and throughout the irrigated area and solid set sprinkler facilities. Disinfection and supplementary pumping are provided between the reservoir and irrigation.

For the City, the upgraded and expanded treatment plant provides 40 mgd of secondary treatment capacity including chemical phosphorus removal. This capacity will serve the City alone to beyond year 2020. No facilities are required until 1990 when the change is made

(1) Initial cost effectiveness analysis does not include the cost of highway or utility relocation and does not include compensation above land cost for resident relocations.

from surface water disposal to rapid percolation. The surface water disposal would meet 1983 standards and the shift to rapid percolation disposal at 1990 is in response to the assumption that more stringent standards for surface water disposal are imposed at that date.

The rapid percolation site for the combined flows of the City and North Spokane is on the terrace adjoining Long Lake. The site is selected for its capability to infiltrate surface applied waters at a high rate and the fact that access to the groundwater which is to receive this reclaimed wastewater could feasibly be controlled. The required percolation area for the forecast flow to year 2000 is 403 acres. The infiltration ponds are multicelled ponds with distribution piping and control structures to permit intermittant application and are constructed in one stage.

The required conveyance from the City STP to the percolation site consists of approximately 12.6 miles of force mains and gravity sewers and pump stations for a total static lift of 186 feet. Equalizing storage is also provided for the effluent pumping.

After completion of the percolation ponds and conveyance structures, the operation of the City STP would be altered to eliminate phosphorus removal which would no longer be needed for percolation disposal.

PLAN H proposes separate treatment and surface water disposal for each of the three main service areas. Throughout the planning period, 1980 to 2000, 1983 treatment standards are applied.

The City of Spokane, including the addition of only Moran

Prairie and Southwest, would utilize the proposed improved and expanded City STP for disposal to the Spokane River at the plant site. The planned expansion to 40 mgd provides capacity for forecast City flows to beyond the year 2020. The proposed upgrade to activated sludge secondary treatment with chemical phosphorus removal requires no basic addition or modification except a minor change to permit seasonal nitrification.

North Spokane would be sewered to the natural point of concentration in the vicinity of the Fish Hatchery. Flows from developed areas west of Five Mile Prairie would be conveyed to the Fish Hatchery area after 1990 by a combination of force main and gravity sewer approximately 4.7 miles long; one pump lift of 314 feet is required.

A secondary treatment plant would be constructed in two stages to a year 2000 capacity of 5.8 mgd at the Fish Hatchery site. The proposed treatment facility is the activated sludge type with chemical phosphorus removal. Treated effluent would be conveyed approximately 4.9 miles for surface water disposal to the Spokane River at the Little Spokane Confluence.

A subalternative for North Spokane of substantially the same cost effectiveness ranking as the basic alternative described above would locate the treatment plant in the vicinity of the confluence rather than in the vicinity of the Fish Hatchery. The basic alternative has a potential advantage if disposal to the Little Spokane River is acceptable in early years. The conveyance to the confluence is approximately one-third of the project capital cost and would

greatly lower present worth if postponed for ten years.

The Spokane Valley would be sewered to its natural point of concentration in the vicinity of the east end of Felts Field. A secondary treatment plant of 10 mgd capacity would be constructed in one stage to serve year 2000 requirements. The treatment plant is an activated sludge plant with chemical phosphorus removal. The secondary treated effluent is conveyed approximately 2 miles downstream for surface water discharge to the Spokane River at a point below the City wells.

PLAN I is the no action plan. The current upgrading and expansion of the City STP is considered an accomplished fact so that the no action plan for the City is treatment of its wastes by secondary treatment with phosphorus removal and disposal to the Spokane River. The North Spokane area is served by both on-site disposal and by small collection systems to interim treatment facilities. The no action plan would continue this arrangement. The Spokane Valley area is served almost entirely by on-site disposal and no action would mean continuation of this practice.

TABLE 1

COSTS OF ALTERNATIVE ELEMENTS

COSTS IN MILLIONS OF DOLLARS PRESENT WORTH OF CAPITAL PLUS OPERATION AND MAINTENANCE

1983 STANDARDS (1)						1985 STANDARDS (2)			
Element(3)	Seasonal P Removal	Year Around P Removal	P Removal Not Involved	Special as Noted Cost	Note	Element (3)	Cost	Special Cost	As Noted Note
C-sw	20.0	23.4	-			C-sw/swt	39.9		
C-1p	-	-	42.1			C-sw/1p	28.6		
C-1i	-	-	88.9	54.6	(5)	C-sw/1i	46.6		
(C+NS)-sw	25.9	29.6	-			(C+NS)-sw/swt	47.9		
(C+NS)-1p	-	-	50.3			(C+NS)-sw/1p	35.2	42.2	(6)
(C+NS)-1i	-	-	102.9	65.7	(5)	(C+NS)-sw/1i	56.1		
				99.6	(7)				
(C+SV)-sw	41.4	45.5	-			(C+SV)-sw/swt	65.7		
(C+SV)-1p			66.6			(C+SV)-sw/1p	51.5		
(C+SV)-1i			125.1	83.0	(5)	(C+SV)-sw/1i	77.3		
(C+NS+SV)-sw	53.8	58.3	-			(C+NS+SV)-sw/swt	80.2		
(C+NS+SV)-1p	-	-	79.8			(C+NS+SV)-sw/1p	64.8		
(C+NS+SV)-1i	-	-	143.9	100.8	(5)	(C+NS+SV)-sw/1i	90.1		
NS-sw	11.3	11.8	-			NS-sw/swt	15.7		
NS-1p	-	-	16.0			NS-sw/1p	13.9		
NS-1i	-	-	15.3			NS-sw/1i	16.4		
SV-sw	16.0	17.2	-			SV-sw/swt	23.0		
SV-1p	-	-	31.6			SV-sw/1p	22.8		
SV-1i	-	-	29.3			SV-sw/1i	25.8		
(NS+SV)-sw	26.8	29.5	-			(NS+SV)-sw/swt	38.0		
(NS+SV)-1p	-	-	45.7			(NS+SV)-1p (4)	45.7		
(NS+SV)-1i	-	-	41.7			(NS+SV)-1i (4)	41.7		

NOTES:

(1) Costs in millions of dollars net present worth of capital and operation costs, 20 year period 1980 - 2000 with 1983 standards in effect throughout.

(2) Costs in millions of dollars net present worth of capital and operation costs, 20 year period 1980 - 2000 with 1983 standards in effect 1980 to 1990 and surface water disposal and interpreted 1985 standards in effect 1990 to 2000 with disposal as indicated.

(3) Legend for identification of alternative elements is as follows:

C = City of Spokane service area
NS = North Spokane service area
SV = Spokane Valley service area
sw = surface water disposal with secondary treatment
1p = land application to rapid percolation
1i = land application to irrigation

swt = surface water disposal with tertiary treatment
sw/swt = sw to 1990, swt after 1990
sw/1p = sw to 1990, 1p after 1990
sw/1i = sw to 1990, 1i after 1990

(4) In these cases, there is no surface water alternative for the 1980 - 1990 period that is cost effectively convertible to 1p or 1i at 1990, hence, 1p and 1i respectively are used throughout the study period.

(5) Subalternative for summer seasonal disposal by land application to irrigation and winter season disposal to surface water. The basic alternative is for disposal of the entire years flow to irrigation. Subalternative is designated 1i-sw.

(6) Subalternative for pretreatment to include full nitrification-denitrification prior to percolation application to the downriver site. The basic alternative is for pretreatment to include secondary treatment without nitrification-denitrification.

(7) Subalternative for pretreatment before irrigation reduced from secondary to primary treatment (noting that capital costs for secondary are sunk).

TABLE 2
COST EFFECTIVENESS RANKING - 1983 ST'DS.
ALL SYSTEMS, SEASONAL P REMOVAL

RANK	SYSTEM	SYSTEM ELEMENTS (1)	(2)	(3)	TOTAL COST MILLION DOLLARS
1	2-1	(C+NS)sw		SV-sw	42.0
2	5-1	(NS+SV)sw	C-sw		46.8
3	1-1	C-sw	NS-sw	SV-sw	47.3
4	1-4	C-sw	NS-li	SV-sw	51.3
5	1-7	C-sw	NS-lp	SV-sw	52.1
6	3-1	(C+SV)sw	NS-sw		52.6
7	4-1	(C+NS+SV)sw			53.8
8	2-2	(C+NS)sw		SV-li	55.3
9	3-2	(C+SV)sw	NS-li		56.7
10	3-3	(C+SV)sw	NS-lp		57.4
11	2-3	(C+NS)sw		SV-lp	57.6
12	1-2	C-sw	NS-sw	SV-li	60.6
13	5-4	(NS+SV)li	C-sw		61.8
14	1-3	C-sw	NS-sw	SV-lp	62.9
15	1-5	C-sw	NS-li	SV-li	64.7
16	1-8	C-sw	NS-lp	SV-li	65.4
17	5-7	(NS+SV)lp	C-sw		65.7
18	2-7	(C+NS)lp		SV-sw	66.3
19	1-6	C-sw	NS-li	SV-lp	66.9
20	1-9	C-sw	NS-lp	SV-lp	67.6
21	5-3	(NS+SV)sw	C-lp		68.9
22	1-19	C-lp	NS-sw	SV-sw	69.4
23	1-22	C-lp	NS-li	SV-sw	73.5
24	1-25	C-lp	NS-lp	SV-sw	74.2
25	3-7	(C+SV)lp	NS-sw		77.9
26	2-8	(C+NS)lp		SV-li	79.6
27	4-3	(C+NS+SV)lp			79.9
28	2-9	(C+SV)lp		SV-lp	81.92
29	3-8	(C+SV)lp	NS-li		81.94
30	3-9	(C+SV)lp	NS-lp		82.6
31	1-20	C-lp	NS-sw	SV-li	82.7
32	5-6	(NS+SV)li	C-lp		83.9
33	1-21	C-lp	NS-sw	SV-lp	85.0
34	1-23	C-lp	NS-li	SV-li	86.8
35	1-26	C-lp	NS-lp	SV-li	87.5
36	5-9	(NS+SV)lp	C-lp		87.8
37	1-24	C-lp	NS-li	SV-lp	89.0
38	1-27	C-lp	NS-lp	SV-lp	89.7
39	5-2	(NS+SV)sw	C-li		115.7
40	1-10	C-li	NS-sw		116.2
41	2-4	(C+NS)li		SV-sw	118.9
42	1-13	C-li	NS-li	SV-sw	120.2
43	1-16	C-li	NS-lp	SV-sw	120.9
44	1-11	C-li	NS-sw	SV-li	129.5
45	5-5	(NS+SV)li	C-li		130.6
46	1-12	C-li	NS-sw	SV-lp	131.8
47	2-5	(C+NS)li		SV-li	132.2
48	1-14	C-li	NS-li	SV-li	133.5
49	1-17	C-li	NS-lp	SV-li	134.2
50	2-6	(C+NS)li		SV-lp	134.5
51	5-8	(NS+SV)lp	C-li		134.6
52	1-15	C-li	NS-li	SV-lp	135.8
53	3-4	(C+SV)li	NS-sw		136.3
54	1-18	C-li	NS-lp	SV-lp	136.5
55	3-5	(C+SV)li	NS-li		140.4
56	3-6	(C+SV)li	NS-lp		141.1
57	4-2	(C+NS+SV)li			143.9

LEGEND

C = City of Spokane service area
NS = North Spokane service area
SV = Spokane Valley service area
sw = surface water disposal with secondary treatment
lp = land application to rapid percolation
li = land application to irrigation
swt = surface water disposal with tertiary treatment
sw/swt = sw to 1990, swt after 1990
sw/lp = sw to 1990, lp after 1990
sw/li = s. to 1990, li after 1990

TABLE 3
COST EFFECTIVENESS RANKING - 1983 ST'DS.
EXCLUSIVE OF SPOKANE VALLEY - SEASONAL P REMOVAL

RANK	SYSTEM	SYSTEM ELEMENTS (1)	(2)	(3)	TOTAL COST MILLION DOLLARS
1	6-10	(C+NS)sw			25.9
2	6-1	C-sw	NS-sw		31.2
3	6-2	C-sw	NS-li		35.3
4	6-3	C-sw	NS-lp		36.0
5	6-12	(C+NS)lp			50.3
6	6-7	C-lp	NS-sw		53.4
7	6-8	C-lp	NS-li		57.4
8	6-9	C-lp	NS-lp		58.1
9	6-4	C-li	NS-sw		100.2
10	6-11	(C+NS)li			102.9
11	6-5	C-li	NS-li		104.2
12	6-6	C-li	NS-lp		104.9

LEGEND

C = City of Spokane service area
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sw = surface water disposal with secondary treatment
lp = land application to rapid percolation
li = land application to irrigation
swt = surface water disposal with tertiary treatment
sw/swt = sw to 1990, swt after 1990
sw/lp = sw to 1990, lp after 1990
sw/li = sw to 1990, li after 1990

TABLE 4
COST EFFECTIVENESS RANKING - 1983 ST'DS.
ALL SYSTEMS, YEAR AROUND P REMOVAL

RANK	SYSTEM	SYSTEM ELEMENTS (1)	(2)	(3)	TOTAL COST MILLION DOLLARS
1	2-1	(C+NS)sw		SV-sw	46.8
2	1-1	C-sw	NS-sw	SV-sw	52.3
3	5-1	(NS+SV)sw	C-sw		52.8
4	1-4	C-sw	NS-li	SV-sw	55.8
5	1-7	C-sw	NS-lp	SV-sw	56.6
6	3-1	(C+SV)sw	NS-sw		57.3
7	4-1	(C+NS+SV)sw			58.3
8	2-2	(C+NS)sw		SV-li	59.0
9	3-2	(C+SV+sw	NS-li		60.9
10	2-3	(C+NS)sw		SV-lp	61.3
11	3-3	(C+SV)sw	NS-lp		61.6
12	1-2	C-sw	NS-sw	SV-li	64.5
13	5-4	(NS+SV)li	C-sw		65.1
14	1-3	C-sw	NS-sw	SV-lp	66.7
15	2-7	(C+NS)lp		SV-sw	67.5
16	1-5	C-sw	NS-li	SV-li	68.0
17	1-8	C-sw	NS-lp	SV-li	68.7
18	5-7	(NS+SV)lp	C-sw		69.0
19	1-6	C-sw	NS-li	SV-lp	70.3
20	1-9	C-sw	NS-lp	SV-lp	71.0
21	1-19	C-lp	NS-sw	SV-sw	71.1
22	5-3	(NS+SV)sw	C-lp		71.6
23	1-22	C-lp	NS-li	SV-sw	74.6
24	1-25	C-lp	NS-lp	SV-sw	75.3
25	3-7	(C+SV)lp	NS-sw		78.4
26	2-8	(C+NS)lp		SV-li	79.6
27	4-3	(C+NS+SV)lp			79.9
28	2-9	(C+NS)lp		SV-lp	81.9
29	3-8	(C+SV)lp	NS-li		81.9
30	3-9	(C+SV)lp	NS-lp		82.6
31	1-20	C-lp	NS-sw	SV-li	83.2
32	5-6	(NS+SV)li	C-lp		83.9
33	1-21	C-lp	NS-sw	SV-lp	85.5
34	1-23	C-lp	NS-li	SV-li	86.8
35	1-26	C-lp	NS-lp	SV-li	87.5
36	5-9	(NS+SV)lp	C-lp		87.8
37	1-24	C-lp	NS-li	SV-lp	89.0
38	1-27	C-lp	NS-lp	SV-lp	89.7
39	1-10	C-li	NS-sw	SV-sw	117.8
40	5-2	(NS+SV)sw	C-li		118.4
41	2-4	(C+NS)li		SV-sw	120.1
42	1-13	C-li	NS-li	SV-sw	121.4
43	1-16	C-li	NS-lp	SV-sw	122.1
44	1-11	C-li	NS-sw	SV-li	130.0
45	5-5	(NS+SV)li	C-li		130.6
46	2-5	(C+NS)li		SV-li	132.2
47	1-12	C-li	NS-sw	SV-lp	132.3
48	1-14	C-li	NS-li	SV-li	133.5
49	1-17	C-li	NS-lp	SV-li	134.2
50	2-6	(C+NS)li		SV-lp	134.5
51	5-8	(NS+SV)lp	C-li		134.6
52	1-15	C-li	NS-li	SV-lp	135.8
53	1-18	C-li	NS-lp	SV-lp	136.5
54	3-4	(C+SV)li	NS-sw		136.8
55	3-5	(C+SV)li	NS-li		140.4
56	3-6	(C+SV)li	NS-lp		141.1
57	4-2	(C+NS+SV)li			143.9

LEGEND

C = City of Spokane service area
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swt = surface water disposal with tertiary treatment
sw/swt = sw to 1990, swt after 1990
sw/lp = sw to 1990, lp after 1990
sw/li = sw to 1990, li after 1990

TABLE 5
COST EFFECTIVENESS RANKING - 1983 ST'DS.
EXCLUSIVE OF SPOKANE VALLEY - YEAR AROUND P REMOVAL

RANK	SYSTEM	SYSTEM ELEMENTS (1)	(2)	(3)	TOTAL COST MILLION DOLLARS
1	6-10	(C+NS)sw			29.6
2	6-1	C-sw	NS-sw		35.1
3	6-2	C-sw	NS-li		38.7
4	6-3	C-sw	NS-lp		39.4
5	6-12	(C+NS)lp			50.3
6	6-7	C-lp	NS-sw		53.9
7	6-8	C-lp	NS-li		57.4
8	6-9	C-lp	NS-lp		58.1
9	6-4	C-li	NS-sw		100.7
10	6-11	(C+NS)li			102.9
11	6-5	C-li	NS-li		104.2
12	6-6	C-li	NS-lp		104.9

LEGEND

C = City of Spokane service area
NS = North Spokane service area
SV = Spokane Valley service area
sw = surface water disposal with secondary treatment
lp = land application to rapid percolation
li = land application to irrigation
swt = surface water disposal with tertiary treatment
sw/swt = sw to 1990, swt after 1990
sw/lp = sw to 1990, lp after 1990
sw/li = sw to 1990, li after 1990

TABLE 6

COST EFFECTIVENESS RANKING - 1985 ST'DS.
ALL SYSTEMS

RANK	SYSTEM	SYSTEM ELEMENTS (1)	(2)	(3)	TOTAL COST MILLION DOLLARS
1	2-9	(C+NS)-sw/1p		SV-sw/1p	58.0
2	2-7	(C+NS)-sw/1p		SV-sw/swt	58.2
3	2-8	(C+NS)-sw/1p		SV-sw/1i	61.0
4	4-3	(C+NS+SV)-sw/1p			64.8
5	1-27	C-sw/1p	NS-sw/1p	SV-sw/1p	65.3
6	3-9	(C+SV)-sw/1p	NS-sw/1p		65.4
7	1-25	C-sw/1p	NS-sw/1p	SV-sw/swt	65.5
8	5-3	(NS+SV)-sw/swt	C-sw/1p		66.6
9	1-21	C-sw/1p	NS-sw/swt	SV-sw/1p	67.1
10	3-7	(C+SV)-sw/1p	NS-sw/swt		67.2
11	1-19	C-sw/1p	NS-sw/swt	SV-sw/swt	67.3
12	1-24	C-sw/1p	NS-sw/1i	SV-sw/1p	67.8
13	3-8	(C+SV)-sw/1p	NS-sw/1i		67.9
14	1-22	C-sw/1p	NS-sw/1i	SV-sw/swt	68.0
15	1-26	C-sw/1p	NS-sw/1p	SV-sw/1i	68.3
16	1-20	C-sw/1p	NS-sw/swt	SV-sw/1i	70.1
17	5-6	*(NS+SV)-1i	C-sw/1p		70.3
18	2-3	(C+NS)-sw/swt		SV-sw/1p	70.7
19	1-23	C-sw/1p	NS-sw/1i	SV-sw/1p	70.8
20	2-1	(C+NS)-sw/swt		SV-sw/swt	70.9
21	2-2	(C+NS)-sw/swt		SV-sw/1i	73.7
22	5-9	*(NS+SV)-1p	C-sw/1p		74.3
23	1-9	C-sw/swt	NS-sw/1p	SV-sw/1p	76.6
24	1-7	C-sw/swt	NS-sw/1p	SV-sw/swt	76.8
25	5-1	(NS+SV)-sw/swt	C-sw/swt		77.9
26	1-3	C-sw/swt	NS-sw/swt	SV-sw/1p	78.4
27	1-1	C-sw/swt	NS-sw/swt	SV-sw/swt	78.6
28	2-6	(C+NS)-sw/1i		SV-sw/1p	78.9
29	1-6	C-sw/swt	NS-sw/1i	SV-sw/1p	79.10
30	2-4	(C+NS)-sw/1i		SV-sw/swt	79.11
31	1-4	C-sw/swt	NS-sw/1i	SV-sw/swt	79.3
32	1-8	C-sw/swt	NS-sw/1p	SV-sw/1i	79.63
33	3-3	(C+SV)-sw/swt	NS-sw/1p		79.66
34	4-1	(C+NS+SV)-sw/swt			80.2
35	1-2	C-sw/swt	NS-sw/swt	SV-sw/1i	81.44
36	3-1	(C+SV)-sw/swt	NS-sw/swt		81.47
37	5-4	*(NS+SV)-1i	C-sw/swt		81.6
38	2-5	(C+NS)-sw/1i		SV-sw/1i	81.9
39	1-5	C-sw/swt	NS-sw/1i	SV-sw/1i	82.1
40	3-2	(C+SV)-sw/swt	NS-sw/1i		82.1
41	1-18	C-sw/1i	NS-sw/1p	SV-sw/1p	83.3
42	1-16	C-sw/1i	NS-sw/1p	SV-sw/swt	83.5
43	5-2	(NS+SV)-sw/swt	C-sw/1i		84.6
44	1-12	C-sw/1i	NS-sw/swt	SV-sw/1p	85.1
45	1-10	C-sw/1i	NS-sw/swt	SV-sw/swt	85.3
46	5-7	*(NS+SV)-1p	C-sw/swt		85.6
47	1-15	C-sw/1i	NS-sw/1i	SV-sw/1p	85.8
48	1-13	C-sw/1i	NS-sw/1i	SV-sw/swt	86.0
49	1-17	C-sw/1i	NS-sw/1p	SV-sw/1i	86.3
50	1-11	C-sw/1i	NS-sw/swt	SV-sw/1i	88.1
51	5-5	*(NS+SV)-1i	C-sw/1i		88.3
52	1-14	C-sw/1i	NS-sw/1i	SV-sw/1i	88.8
53	4-2	(C+NS+SV)-sw/1i			90.1
54	3-6	(C+SV)-sw/1i	NS-sw/1p		91.2
55	5-8	*(NS+SV)-1p	C-sw/1i		92.3
56	3-4	(C+SV)-sw/1i	NS-sw/swt		93.0
57	3-5	(C+SV)-sw/1i	NS-sw/1i		93.7

*See Note (4) on Table 1.

LEGEND

C = City of Spokane service area
NS = North Spokane service area
SV = Spokane Valley service area
sw = surface water disposal with secondary treatment
1p = land application to rapid percolation
1i = land application to irrigation
swt = surface water disposal with tertiary treatment
sw/swt = sw to 1990, swt after 1990
sw/1p = sw to 1990, 1p after 1990
sw/1i = sw to 1990, 1i after 1990

TABLE 7

COST EFFECTIVENESS RANKING - 1985+ ST'DS.
EXCLUDING SPOKANE VALLEY

RANK	SYSTEM	SYSTEM ELEMENTS (1)	(2)	(3)	TOTAL COST MILLION DOLLARS
1	6-12	(C+NS)sw/lp			35.2
2	6-9	C-sw/lp	NS-sw/lp		42.5
3	6-7	C-sw/lp	NS-sw/swt		44.3
4	6-8	C-sw/lp	NS-sw/li		45.0
5	6-10	(C+NS)sw/swt			47.9
6	6-3	C-sw/swt	NS-sw/lp		53.8
7	6-1	C-sw/swt	NS-sw/swt		55.6
8	6-11	(C+NS)sw/li			56.1
9	6-2	C-sw/swt	NS-sw/li		56.3
10	6-6	C-sw/li	NS-sw/lp		60.5
11	6-4	C-sw/li	NS-sw/swt		62.3
12	6-5	C-sw/li	NS-sw/li		63.0

LEGEND

C = City of Spokane service area
NS = North Spokane service area
SV = Spokane Valley service area
sw = surface water disposal with secondary treatment
lp = land application to rapid percolation
li = land application to irrigation
swt = surface water disposal with tertiary treatment
sw/swt = sw to 1990, swt after 1990
sw/lp = sw to 1990, lp after 1990
sw/li = sw to 1990, li after 1990

SELEC

GOALS	PLAN A (C+NS)sw, SV-sw	PLAN B C-sw, NS-li, SV-sw	PLAN C (C+NS+SV)sw
1. Cost and maximum use of existing fac.	* 42.0 million $ makes 100% use of exist. city STP.	51.3 million $ leaves part of the City STP capacity unused.	53.8 million $ uses all City STP capacity but r an addition also.
2. Maximize protection of surface waters.	All treated wastes are discharged to sw. Protection depends on degree of treatment and system reliability.	Only a small part of total to land disposal. Protection of sw. depends on degree of treatment and system reliability.	Surface water discharge centrated at one point. tection depends on trea system and reliability.
3. Maximize protection of groundwaters.	Eliminates all waste disch. to gw except that due to river interchange downstream from SV discharge.	Part to irrigation on a minor aquifer. Low threat to gw.	* Eliminates all waste to gw except minor recharge downstream City STP.
4. Maximize water reclamation and reuse.	None directly except that water is available by diversion from river below points of discharge.	Small part to land irrigation, remainder to river disposal.	None directly except th water is available by d from river downstream f
5. Minimize disruption of natural habitat.	No disruption to land habitat. Some to river water habitat.	Land for lagoons and irrigation subject to change. Most to river where there is some change to river habitat.	* No disruption to lan habitat. Some to ri water habitat below
6. Minimize displacement of people.	* No potential for displacement of people.	Portion to land irrigation will displace homeowners and farmers.	No potential for displa of people. Major const disruption to bring SV STP.
7. Minimize disruption of land use.	* No potential for change in land use.	Portion to land irrigation will change land use for reservoir lagoon and irrigation.	* No potential for ch land use.
8. Minimize energy consumption.	* Best for minimum energy use.	Good except for part to irrigation. Irrigation requires significant pumping.	Fair but requires more SV separate due to pum from SV to City STP.
9. Posess maximum potential for 1985 goal achievement.	Facilities needed would be useable in going to future conversion to land application.	Facilities needed would be useable in going to future conversion to land application.	Facilities needed woul useable in going to fu conversion to land app tion.

*An asterisk indicates a goal that is well met by an alternative plan or plans. These asterisks are not intende goal but rather a comparatively high degree of satisfaction.

TABLE 8
SELECTION OF CANDIDATE PLANS

PLAN C (C+NS+SV)sw	PLAN D (C+NS)sw/1p, SVsw/1p	PLAN E (C+NS)li-sw, SV-li	PLAN F (C+NS)li, SV-li
53.8 million $ uses all exist. City STP capacity but requires an addition also.	58.0 million $ makes 100% use of exist. City STP.	95.0 million $. Makes 100% use of exist. City STP.	132.2 million $. Makes 100% use of exist. City STP.
Surface water discharge concentrated at one point. Protection depends on treatment system and reliability.	Until 1990, is a sw. discharge system same as (C+NS)sw, SVsw. No sw discharge after 1990.	For C+NS portion, sw discharge eliminated only during summer.	* No direct sw discharge. There is some potential for washoff to sw from vast irrigated areas.
* Eliminates all waste disch. to gw except minor river recharge downstream from City STP.	After 1990, C+NS discharges to gw at extreme downstream end of primary aquifer below point of significant potential for withdrawal and domestic utilization. SV after 1990 discharges to near downstream of primary aquifer.	No direct discharge to gw but potential recharge from irrigation to Basalt aquifer by (C+NS) and to Peone Prairie by SV.	No direct discharge to gw but major potential recharge of Dragoon Creek aquifer by percolation from irrigation.
None directly except that water is available by diversion from river downstream from STP.	None directly.	Reuses summer flow from (C+NS) component and entire SV component to irrigation. Winter flow from C+NS discharged to sw.	* Reuses entire waste flow for irrigation.
* No disruption to land habitat. Some to river water habitat below STP.	No disruption to land habitat to 1990. After 1990 significant areas for ponds are taken.	Significant land areas taken for irrigation but area for (C+NS) presently not regarded as valuable habitat.	Would take major areas and change from dry or partial irrigation to concentrated heavy irrigation.
No potential for displacement of people. Major construction disruption to bring SV to City STP.	No displacement until 1990. Sites required for 1p has low present occupancy.	Site required for (C+NS) li has low occupancy. Site for SV-li now occupied by dry farming.	Causes maximum displacement of people due to areas required for full flow to irrigation.
* No potential for change in land use.	No disruption until 1990. Site required for C+NS 1p has high residential potential which would be lost.	* Site required for (C+NS)li has low utility now. Change to irrigation could be beneficial.	Causes maximum tie up of land area devoted to project.
Fair but requires more than SV separate due to pumping from SV to City STP.	One of the lower energy use alternatives that would meet 1985 st'ds.	High energy required during summer to lift to irrigation but left eliminated during winter with sw disposal.	Has highest energy use due to total flow pumped to high elevations for irrigation.
Facilities needed would be useable in going to future conversion to land application.	* Specifically to meet interpreted 1985 standards at lowest cost.	Not readily converted to 1985 standards due to lack of area at seasonal site for full year disposal.	* Meets 1985 standards.

asterisks are not intended to indicate unqualified meeting of a

LAN E	PLAN F	PLAN G	PLAN H
-sw, SV-li	(C+NS)li, SV-li	(NS+SV)li, Csw/lp	C-sw, NS-sw, SV-sw
Makes 100% ity STP.	132.2 million $. Makes 100% use of exist. City STP.	70.3 million $ leaves part of the City STP capacity unused.	47.3 million $ leaves part of City STP capacity unused.
on, sw nated mer.	* No direct sw discharge. There is some potential for washoff to sw from vast irrigated areas.	City to sw until 1990. There is only indirect return from lp after. Only small potential to sw from li disposal by NS+SV.	All treated wastes are discharge to sw. Protection depends on degree of treatment and system reliability.
arge to gw echarge to Basalt S) and to y SV.	No direct discharge to gw but major potential recharge of Dragoon Creek aquifer by percolation from irrigation.	No direct discharge to gw until 1990, then to far downstream end of primary aquifer below point of present significant use.	Eliminates all water discharge to groundwater except that due to interchange downstream from SV discharge.
low from t and ent to ter discharged	* Reuses entire waste flow for irrigation.	NS+SV flows to irrigation reuse. No City flow to reuse.	None directly except that water is available by diversion from river below points of discharge.
areas tion but presently valuable	Would take major areas and change from dry or partial irrigation to concentrated heavy irrigation.	Significant land areas taken for irrigation and after 1990 for percolation.	No disruption to land habitat. Some to river habitat at 3 locations.
r (C+NS) ancy. ow occupied	Causes maximum displacement of people due to areas required for full flow to irrigation.	Irrigation areas are in area presently dry farmed. Percolation site presently lightly settled.	* No potential for displacement of people.
for (C+NS)li ty now. igation ficial.	Causes maximum tie up of land area devoted to project.	Takes land for irrigation. The City percolation site has high residential potential which would be lost.	* No potential for change in land use.
ired during to irrigation ted during isposal.	Has highest energy use due to total flow pumped to high elevations for irrigation.	Rates moderate for energy use compared with others.	* Next lowest energy use to Plan A.
erted to ue to lack nal site isposal.	* Meets 1985 standards.	* Meets 1985 standards.	Facilities needed would be useable in going to higher level of treatment or to land application.

APPENDICES I THROUGH V

General Notes:

1. All costs are present worth reduced to the base year of the planning period 1980.

2. The planning period is the twenty year period from 1980 through the year 1999.

3. All costs are at the price level of mid-1974, ENR = 2000.

4. The symbol < > indicates a negative number. These result from the present worth of salvage credit of sunk cost items and credit for land application revenue.

APPENDIX Ia
ELEMENT COST SUMMARY, 1983 STD.

Alternative: C-sw Subalternative: Seasonal P Removal

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.			
Service Area Conveyance, Land			
Treatment Facilities, Const.	98,000	14,102,000	14,200,000
Treatment Facilities, Land	<26,000>		< 26,000>
Disposal Conveyance, Const.			
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	98,000	14,102,000	14,200,000
Subtotal w/o solids, land	<26,000>		<26,000>
Total w/o solids	72,000	14,102,000	14,174,000
Solids Facilities, Const.	<223,000>	5,944,000	5,721,000
Solids Facilities, Land	125,000		125,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	<125,000>	20,046,000	19,921,000
SUBTOTAL incl. solids, LAND	99,000		99,000
TOTAL incl. solids	<26,000>	20,046,000	20,020,000

Notes:

APPENDIX Ib
ELEMENT COST SUMMARY, 1983 STD.

Alternative: NS-50) Subalternative: Seasonal P Removal

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	381,000	48,000	429,000
Service Area Conveyance, Land	1,000		1,000
Treatment Facilities, Const.	3,993,000	2,201,000	6,194,000
Treatment Facilities, Land	39,000		39,000
Disposal Conveyance, Const.	2,062,000	249,000	2,311,000
Disposal Conveyance, Land	13,000		13,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		( )	
Subtotal w/o solids, construction	6,436,000	2,498,000	8,934,000
Subtotal w/o solids, land	53,000		53,000
Total w/o solids	6,487,000	2,498,000	8,987,000
Solids Facilities, Const.	1,175,000	1,079,000	2,254,000
Solids Facilities, Land	15,000		15,000
Solids Facilities, Revenue		( )	
SUBTOTAL incl. solids, CONST.	7,611,000	3,577,000	11,188,000
SUBTOTAL incl. solids, LAND	68,000		68,000
TOTAL incl. solids	7,679,000	3,577,000	11,256,000

Notes:

APPENDIX Ic
ELEMENT COST SUMMARY, 1983 STD.

Alternative: SV-sw Subalternative: Seasonal P Removal

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.			
Service Area Conveyance, Land			
Treatment Facilities, Const.	6,707,000	4,136,000	10,843,000
Treatment Facilities, Land	26,000		26,000
Disposal Conveyance, Const.	1,547,000	65,000	1,612,000
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	8,254,000	4,201,000	12,455,000
Subtotal w/o solids, land	26,000		26,000
Total w/o solids			
Solids Facilities, Const.	1,621,000	1,907,000	3,528,000
Solids Facilities, Land	31,000		31,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	9,875,000	6,108,000	15,983,000
SUBTOTAL incl. solids, LAND	57,000		57,000
TOTAL incl. solids	9,932,000	6,108,000	16,040,000

Notes:

APPENDIX Id

ELEMENT COST SUMMARY, 1983 STD.

Alternative: (C+NS)-sw Subalternative: Seasonal P Removal

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	4,769,000	526,000	5,295,000
Service Area Conveyance, Land	5,000		5,000
Treatment Facilities, Const.	98,000	14,509,000	14,607,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.			
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	4,867,000	15,035,000	19,902,000
Subtotal w/o solids, land	<21,000>		<21,000>
Total w/o solids	4,846,000	15,035,000	19,881,000
Solids Facilities, Const.	<223,000>	6,135,000	5,912,000
Solids Facilities, Land	141,000		141,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	4,644,000	21,170,000	25,814,000
SUBTOTAL incl. solids, LAND	120,000		120,000
TOTAL incl. solids	4,764,000	21,170,000	25,934,000

Notes:

APPENDIX Ie

ELEMENT COST SUMMARY, 1983 STD.

Alternative: (C+W)-SW **Subalternative:** Seasonal P Removal

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	7,806,000	561,000	8,367,000
Service Area Conveyance, Land	2,000		2,000
Treatment Facilities, Const.	6,762,000	16,920,000	23,682,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.			
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	14,568,000	17,481,000	32,049,000
Subtotal w/o solids, land	<24,000>		<24,000>
Total w/o solids	14,544,000	17,481,000	32,025,000
Solids Facilities, Const.	2,084,000	7,101,000	9,185,000
Solids Facilities, Land	158,000		158,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	16,652,000	24,582,000	41,23[illegible],000
SUBTOTAL incl. solids, LAND	134,000		13[illegible],000
TOTAL incl. solids	16,786,000	24,582,000	41,36[illegible],000

Notes:

APPENDIX If
ELEMENT COST SUMMARY, 1983 STD.

Alternative: (C+NS+SV)-sw **Subalternative:** Seasonal P Removal

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	12,574,000	1,086,000	13,660,000
Service Area Conveyance, Land	7,000		7,000
Treatment Facilities, Const.	10,380,000	18,505,000	28,885,000
Treatment Facilities, Land	⟨26,000⟩		⟨26,000⟩
Disposal Conveyance, Const.			
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		⟨ ⟩	
Subtotal w/o solids, construction	22,954,000	19,591,000	42,545,000
Subtotal w/o solids, land	⟨19,000⟩		⟨19,000⟩
Total w/o solids	22,935,000	19,591,000	42,526,000
Solids Facilities, Const.	3,346,000	7,739,000	11,085,000
Solids Facilities, Land	174,000		174,000
Solids Facilities, Revenue		⟨ ⟩	
SUBTOTAL incl. solids, CONST.	26,300,000	27,330,000	53,630,000
SUBTOTAL incl. solids, LAND	155,000		155,000
TOTAL incl. solids	26,455,000	27,330,000	53,785,000

Notes:

APPENDIX Ig

ELEMENT COST SUMMARY, 1983 STD.

Alternative: (NS+SV)-SW **Subalternative:** Seasonal P Removal

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	5,963,000	640,000	6,603,000
Service Area Conveyance, Land	8,000		8,000
Treatment Facilities, Const.	8,991,000	4,333,000	13,324,000
Treatment Facilities, Land	35,000		35,000
Disposal Conveyance, Const.	2,068,000	86,000	2,154,000
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	17,022,000	5,059,000	22,081,000
Subtotal w/o solids, land	43,000		43,000
Total w/o solids	17,065,000	5,059,000	22,124,000
Solids Facilities, Const.	2,225,000	2,417,000	4,642,000
Solids Facilities, Land	45,000		45,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	19,247,000	7,476,000	26,723,000
SUBTOTAL incl. solids, LAND	88,000		88,000
TOTAL incl. solids	19,335,000	7,476,000	26,811,000

Notes:

APPENDIX IIa

ELEMENT COST SUMMARY, 1983 STD.

Alternative: C-aw **Subalternative:** Full Time P Removal

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.			
Service Area Conveyance, Land			
Treatment Facilities, Const.	98,000	17,184,000	17,283,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.			
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	98,000	17,184,000	17,282,000
Subtotal w/o solids, land	<26,000>		<26,000>
Total w/o solids	72,000	17,184,000	17,255,000
Solids Facilities, Const.	<223,000	6,178,000	5,955,000
Solids Facilities, Land	143,000		143,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	<125,000>	23,362,000	23,237,000
SUBTOTAL incl. solids, LAND	117,000		117,000
TOTAL incl. solids	<8,000	23,362,000	23,354,000

Notes:

APPENDIX II h

ELEMENT COST SUMMARY, 198[illegible] STD.

Alternative: [illegible] Subalternative: Full Time P Removal

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	381,000	48,000	429,000
Service Area Conveyance, Land	1,000		1,000
Treatment Facilities, Const.	3,933,000	2,633,000	6,656,000
Treatment Facilities, Land	39,000		39,000
Disposal Conveyance, Const.	2,062,000	249,000	2,311,000
Disposal Conveyance, Land	13,000		13,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	6,436,000	2,960,000	9,396,000
Subtotal w/o solids, land	53,000		53,000
Total w/o solids	6,489,000	2,960,000	9,449,000
Solids Facilities, Const.	1,175,000	1,115,000	[illegible]
Solids Facilities, Land	17,000		17,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	7,611,000	4,075,000	11,6[illegible]
SUBTOTAL incl. solids, LAND	[illegible]		70,000
TOTAL incl. solids	7,681,000	4,175,000	11,75[illegible]

Notes:

APPENDIX IIc
ELEMENT COST SUMMARY, 1983 STD.

Alternative: SV-[illegible] Subalternative: Full Time P Removal

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.			
Service Area Conveyance, Land			
Treatment Facilities, Const.	6,707,000	5,190,000	11,897,000
Treatment Facilities, Land	26,000		26,000
Disposal Conveyance, Const.	1,547,000	65,000	1,612,000
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	8,254,000	5,255,000	13,509,000
Subtotal w/o solids, land	26,000		26,000
Total w/o solids	8,280,000	5,255,000	13,535,000
Solids Facilities, Const.	1,621,000	1,999,000	3,620,000
Solids Facilities, Land	37,000		37,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	9,875,000	7,254,000	17,129,000
SUBTOTAL incl. solids, LAND	63,000		63,000
TOTAL incl. solids	9,938,000	7,254,000	17,192,000

Notes:

APPENDIX II d

ELEMENT COST SUMMARY, 1983 STD.

Alternative: (C+NS)-sw Subalternative: Full Time P Removal

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	4,769,000	526,000	5,295,000
Service Area Conveyance, Land	5,000		5,000
Treatment Facilities, Const.	98,000	17,945,000	18,043,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.			
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	4,867,000	18,471,000	23,338,000
Subtotal w/o solids, land	<21,000>		<21,000>
Total w/o solids	4,846,000	18,471,000	23,317,000
Solids Facilities, Const.	<233,000>	6,375,000	6,152,000
Solids Facilities, Land	161,000		161,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	4,644,000	24,846,000	29,490,000
SUBTOTAL incl. solids, LAND	140,000		140,000
TOTAL incl. solids	4,784,000	24,846,000	29,630,000

Notes:

APPENDIX [illegible]

ELEMENT COST SUMMARY, [illegible] STD.

Alternative: (C+SV)-[illegible] **Subalternative:** Full Time P[illegible]

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	7,806,000	561,000	8,367,000
Service Area Conveyance, Land	2,000		2,000
Treatment Facilities, Const.	6,762,000	20,809,000	27,571,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.			
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	14,568,000	21,370,000	35,938,000
Subtotal w/o solids, land	<24,000>		<24,000>
Total w/o solids	14,544,000	21,370,000	35,914,000
Solids Facilities, Const.	2,084,000	7,370,000	9,454,000
Solids Facilities, Land	186,000		186,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	16,652,000	28,740,000	45,392,000
SUBTOTAL incl. solids, LAND	162,000		162,000
TOTAL incl. solids	16,814,000	28,740,000	45,554,000

Notes:

APPENDIX II-2

ELEMENT COST SUMMARY, 1983 STD.

Alternative: (C+N+SV)-[illegible] Subalternative: Full Time P Removal

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	12,574,000	4086,000	13,[illegible]
Service Area Conveyance, Land	7,000		7,[illegible]
Treatment Facilities, Const.	10,380,000	22,734,000	33,144,000
Treatment Facilities, Land	<26,[illegible]>		<26,[illegible]>
Disposal Conveyance, Const.			
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	22,954,000	23,820,000	46,774,000
Subtotal w/o solids, land	<19,000>		<19,000>
Total w/o solids	22,935,000	23,820,000	46,755,000
Solids Facilities, Const.	3,346,000	8,024,000	11,370,000
Solids Facilities, Land	199,000		199,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	26,300,000	31,844,000	58,144,000
SUBTOTAL incl. solids, LAND	180,000		180,000
TOTAL incl. solids	26,480,000	31,844,000	58,[illegible]

Notes:

APPENDIX IIg
ELEMENT COST SUMMARY @ 1983 STD.

Alternative: (13+51)-... **Subalternative:** Full Time P Removal

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	5,963,000	640,000	6,603,000
Service Area Conveyance, Land	8,000		8,000
Treatment Facilities, Const.	8,991,000	6,855,000	15,846,000
Treatment Facilities, Land	35,000		35,000
Disposal Conveyance, Const.	2,068,000	86,000	2,154,000
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	17,022,000	7,581,000	24,603,000
Subtotal w/o solids, land	43,000		43,000
Total w/o solids	17,065,000	7,581,000	24,646,000
Solids Facilities, Const.	2,225,000	2,547,000	4,772,000
Solids Facilities, Land	54,000		54,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	19,247,000	10,128,000	29,375,000
SUBTOTAL incl. solids, LAND	97,000		97,000
TOTAL incl. solids	19,344,000	10,128,000	29,472,000

Notes:

APPENDIX Ia
ELEMENT COST SUMMARY, [illegible] STD.

Alternative: [illegible] **Subalternative:** ______

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.			
Service Area Conveyance, Land			
Treatment Facilities, Const.	<612,000>	10,247,000	9,635,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.	14,606,000	2,402,000	17,008,000
Disposal Conveyance, Land	5,000		5,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.	7,460,000	2,797,000	3,543,000
Land Application, Land	919,000		919,000
Land Application, Revenue		< >	
Subtotal w/o solids, construction	21,454,000	15,446,000	[illegible]
Subtotal w/o solids, land	898,000		898,000
Total w/o solids	22,352,000	15,446,000	37,798,000
Solids Facilities, Const.	<223,000>	4,438,000	4,215,000
Solids Facilities, Land	103,000		103,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	21,231,000	[illegible]	41,115,000
SUBTOTAL incl. solids, LAND	1,001,000		1,001,000
TOTAL incl. solids	22,232,000	[illegible]	42,116,000

Notes:

APPENDIX IIIb
ELEMENT COST SUMMARY, 1983 STD.

Alternative: N/S-10 Subalternative: ____________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	381,000	49,000	429,000
Service Area Conveyance, Land	1,000		1,000
Treatment Facilities, Const.	6,710,000	3,282,000	9,992,000
Treatment Facilities, Land	52,000		52,000
Disposal Conveyance, Const.	1,387,000	306,000	1,693,000
Disposal Conveyance, Land	2,000		2,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.	1,050,000	605,000	1,655,000
Land Application, Land	199,000		199,000
Land Application, Revenue		< >	
Subtotal w/o solids, construction	9,528,000	4,241,000	13,769,000
Subtotal w/o solids, land	254,000		254,000
Total w/o solids	9,782,000	4,241,000	14,023,000
Solids Facilities, Const.	1,048,000	921,000	1,969,000
Solids Facilities, Land	13,000		13,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	10,576,000	5,162,000	15,738,000
SUBTOTAL incl. solids, LAND	267,000		267,000
TOTAL incl. solids	10,843,000	5,162,000	16,005,000

Notes:

APPENDIX II c

ELEMENT COST SUMMARY, 198[illegible] STD.

Alternative: 5V-4p **Subalternative:** ______

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.			
Service Area Conveyance, Land			
Treatment Facilities, Const.	11,075,000	6,200,000	11,031,000
Treatment Facilities, Land	36,000		36,000
Disposal Conveyance, Const.	7,616,000	667,000	8,283,000
Disposal Conveyance, Land	4,000		4,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.	2,042,000	1,021,000	3,063,000
Land Application, Land	152,000		152,000
Land Application, Revenue		< >	
Subtotal w/o solids, construction	20,733,000	7,688,000	28,421,000
Subtotal w/o solids, land	192,000		192,000
Total w/o solids	20,925,000	7,688,000	28,613,000
Solids Facilities, Const.	1,348,000	1,635,000	2,983,000
Solids Facilities, Land	27,000		27,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	22,0[illegible]	9,[illegible]3,000	31,404,000
SUBTOTAL incl. solids, LAND	21[illegible]		219,000
TOTAL incl. solids	22,300,000	9,323,[illegible]	31,623,[illegible]

Notes:

APPENDIX III-√

ELEMENT COST SUMMARY, 1983 STD.

Alternative: (C+NS)-Lu Subalternative: ______________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	4,769,000	526,000	5,295,000
Service Area Conveyance, Land	5,000		5,000
Treatment Facilities, Const.	<612,000>	10,299,000	9,867,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.	15,263,000	2,597,000	17,860,000
Disposal Conveyance, Land	6,000		6,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.	8,735,000	3,136,000	11,871,000
Land Application, Land	1,118,000		1,118,000
Land Application, Revenue		< >	
Subtotal w/o solids, construction	28,155,000	16,558,000	44,713,000
Subtotal w/o solids, land	1,103,000		1,103,000
Total w/o solids	29,258,000	16,558,000	45,816,000
Solids Facilities, Const.	<223,000>	4,[illegible]95,[illegible]	4,327,000
Solids Facilities, Land	115,000		115,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	27,932,000	[illegible]	49,0[illegible]
SUBTOTAL incl. solids, LAND	1,218,[illegible]		1,2[illegible]
TOTAL incl. solids	29,150,000	21,153,000	50,303,000

Notes:

APPENDIX III.c

ELEMENT COST SUMMARY, ______ STD.

Alternative: (C+SV)-lp Subalternative: ____________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	7,806,000	561,000	8,367,000
Service Area Conveyance, Land	2,000		2,000
Treatment Facilities, Const.	5,832,000	12,020,000	17,852,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.	16,748,000	2,797,000	19,545,000
Disposal Conveyance, Land	6,000		6,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.	9,661,000	3,337,000	12,998,000
Land Application, Land	1,223,000		1,223,000
Land Application, Revenue		< >	
Subtotal w/o solids, construction	40,047,000	18,715,000	58,762,000
Subtotal w/o solids, land	1,205,000		1,205,000
Total w/o solids	41,252,000	18,715,000	59,967,000
Solids Facilities, Const.	1,201,000	5,346,000	6,547,000
Solids Facilities, Land	130,000		130,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	41,248,000	24,061,000	65,309,000
SUBTOTAL incl. solids, LAND	1,335,000		1,3[illegible]
TOTAL incl. solids	42,583,000	24,061,000	66,644,000

Notes:

APPENDIX III f

ELEMENT COST SUMMARY, 1983 STD.

Alternative: (C+NS+SV)-lp Subalternative: ____________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	12,574,000	1,086,000	13,660,000
Service Area Conveyance, Land	7,000		7,000
Treatment Facilities, Const.	9,359,000	13,111,000	22,470,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.	17,534,000	3,051,000	20,585,000
Disposal Conveyance, Land	7,000		7,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.	10,301,000	3,504,000	13,805,000
Land Application, Land	1,418,000		1,418,000
Land Application, Revenue		< >	
Subtotal w/o solids, construction	49,768,000	20,752,000	70,520,000
Subtotal w/o solids, land	1,406,000		1,406,000
Total w/o solids	51,174,000	20,752,000	71,926,000
Solids Facilities, Const.	1,980,000	5,835,000	7,815,000
Solids Facilities, Land	143,000		143,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	51,748,000	26,587,000	78,335,000
SUBTOTAL incl. solids, LAND	1,549,000		1,5[illegible]000
TOTAL incl. solids	53,297,000	26,587,000	79,884,000

Notes:

APPENDIX III-3

ELEMENT COST SUMMARY, 1983 STD.

Alternative: (NS+SV)-lp Subalternative: ______

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	9,992,000	805,000	10,797,000
Service Area Conveyance, Land	8,000		8,000
Treatment Facilities, Const.	15,049,000	7,568,000	22,617,000
Treatment Facilities, Land	99,000		99,000
Disposal Conveyance, Const.	2,531,000	629,000	3,160,000
Disposal Conveyance, Land	2,000		2,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.	3,129,000	1,400,000	4,529,000
Land Application, Land	504,000		504,000
Land Application, Revenue		< >	
Subtotal w/o solids, construction	30,701,000	10,402,000	41,103,000
Subtotal w/o solids, land	613,000		613,000
Total w/o solids	31,314,000	10,402,000	41,716,000
Solids Facilities, Const.	1,846,000	2,053,000	3,899,000
Solids Facilities, Land	40,000		40,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	32,547,000	12,455,000	45,002,000
SUBTOTAL incl. solids, LAND	653,000		653,000
TOTAL incl. solids	33,200,000	12,455,000	45,655,000

Notes:

APPENDIX III h
ELEMENT COST SUMMARY, 1983 STD.

Alternative: C-2 **Subalternative:** Full Year to Prufer Res

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.			
Service Area Conveyance, Land			
Treatment Facilities, Const.	<612,000>	10,247,000	9,635,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.	21,159,000	4,405,000	25,564,000
Disposal Conveyance, Land	15,000		15,000
Reservoir Storage, Const.	5,715,000	214,000	5,929,000
Reservoir Storage, Land	270,000		270,000
Land Application, Const.	40,779,000	6,518,000	47,297,000
Land Application, Land	8,379,000		8,379,000
Land Application, Revenue		<12,482,000>	<12,482,000>
Subtotal w/o solids, construction	67,041,000	8,902,000	75,943,000
Subtotal w/o solids, land	8,638,000		8,638,000
Total w/o solids	75,679,000	8,902,000	84,581,000
Solids Facilities, Const.	<223,000>	4,438,000	4,215,000
Solids Facilities, Land	103,000		103,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	66,818,000	13,340,000	80,158,000
SUBTOTAL incl. solids, LAND	8,741,000		8,741,000
TOTAL incl. solids	75,559,000	13,340,000	88,899,000

Notes:

APPENDIX III i

ELEMENT COST SUMMARY, 1983 STD.

Alternative: NS-li Subalternative: ____________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	3,979,000	490,000	4,469,000
Service Area Conveyance, Land	2,000		2,000
Treatment Facilities, Const.	1,391,000	615,000	2,006,000
Treatment Facilities, Land	95,000		95,000
Disposal Conveyance, Const.	822,000	194,000	1,016,000
Disposal Conveyance, Land	1,000		1,000
Reservoir Storage, Const.	2,075,000	92,000	2,167,000
Reservoir Storage, Land	217,000		217,000
Land Application, Const.	5,319,000	748,000	6,067,000
Land Application, Land	729,000		729,000
Land Application, Revenue		<1,497,000>	<1,497,000>
Subtotal w/o solids, construction	13,586,000	642,000	14,228,000
Subtotal w/o solids, land	1,044,000		1,044,000
Total w/o solids	14,630,000	642,000	15,272,000
Solids Facilities, Const.		28,000	28,000
Solids Facilities, Land	1,000		1,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	13,586,000	670,000	14,256,000
SUBTOTAL incl. solids, LAND	1,045,000		1,045,000
TOTAL incl. solids	14,631,000	670,000	15,301,000

Notes:

APPENDIX III

ELEMENT COST SUMMARY, 1983 STD.

Alternative: 5V-li Subalternative: ____________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	8,759,000	721,000	9,480,000
Service Area Conveyance, Land	2,000		2,000
Treatment Facilities, Const.	2,816,000	1,018,000	3,834,000
Treatment Facilities, Land	163,000		163,000
Disposal Conveyance, Const.	1,049,000	323,000	1,372,000
Disposal Conveyance, Land	1,000		1,000
Reservoir Storage, Const.	3,043,000	92,000	3,135,000
Reservoir Storage, Land	261,000		261,000
Land Application, Const.	11,107,000	1,648,000	12,755,000
Land Application, Land	1,598,000		1,598,000
Land Application, Revenue		<3,321,000>	<3,321,000>
Subtotal w/o solids, construction	26,774,000	481,000	27,255,000
Subtotal w/o solids, land	2,025,000		2,025,000
Total w/o solids	28,799,000	481,000	29,280,000
Solids Facilities, Const.		58,000	58,000
Solids Facilities, Land	2,000		2,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	26,774,000	539,000	27,313,000
SUBTOTAL incl. solids, LAND	2,027,000		2,027,000
TOTAL incl. solids	28,801,000	539,000	29,340,000

Notes:

APPENDIX III K
ELEMENT COST SUMMARY, 1983 STD.

Alternative: (C+NS)-li Subalternative: Full Year to Prufer Res

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	4,769,000	526,000	5,295,000
Service Area Conveyance, Land	5,000		5,000
Treatment Facilities, Const.	<612,000>	10,299,000	9,687,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.	23,704,000	4,604,000	28,308,000
Disposal Conveyance, Land	16,000		16,000
Reservoir Storage, Const.	6,025,000	214,000	6,239,000
Reservoir Storage, Land	285,000		285,000
Land Application, Const.	45,830,000	7,293,000	53,123,000
Land Application, Land	9,399,000		9,399,000
Land Application, Revenue		<13,951,000>	<13,951,000>
Subtotal w/o solids, construction	79,716,000	8,985,000	88,701,000
Subtotal w/o solids, land	9,679,000		9,679,000
Total w/o solids	89,395,000	8,985,000	98,380,000
Solids Facilities, Const.	<223,000>	4,595,000	4,372,000
Solids Facilities, Land	115,000		115,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	79,493,000	13,580,000	93,073,000
SUBTOTAL incl. solids, LAND	9,794,000		9,794,000
TOTAL incl. solids	89,287,000	13,580,000	102,867,000

Notes:

APPENDIX III l
ELEMENT COST SUMMARY, 1983 STD.

Alternative: (C+SV)-li Subalternative: Full Year to Prufer Res

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	7,806,000	561,000	8,367,000
Service Area Conveyance, Land	2,000		2,000
Treatment Facilities, Const.	5,832,000	12,020,000	17,852,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.	25,617,000	4,997,000	30,614,000
Disposal Conveyance, Land	16,000		16,000
Reservoir Storage, Const.	6,272,000	214,000	6,486,000
Reservoir Storage, Land	300,000		300,000
Land Application, Const.	51,704,000	8,247,000	59,951,000
Land Application, Land	10,616,000		10,616,000
Land Application, Revenue		<15,803,000>	<15,803,000>
Subtotal w/o solids, construction	97,231,000	10,236,000	107,467,000
Subtotal w/o solids, land	10,908,000		10,908,000
Total w/o solids	108,139,000	10,236,000	118,375,000
Solids Facilities, Const.	1,201,000	5,346,000	6,547,000
Solids Facilities, Land	130,000		130,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	98,432,000	15,582,000	114,014,000
SUBTOTAL incl. solids, LAND	11,038,000		11,038,000
TOTAL incl. solids	109,470,000	15,582,000	125,052,000

Notes:

APPENDIX IIIm
ELEMENT COST SUMMARY, 1983 STD.

Alternative: (C+NS+SY)-li **Subalternative:** Full Year to Prufer Res

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	12,574,000	1,086,000	13,660,000
Service Area Conveyance, Land	7,000		7,000
Treatment Facilities, Const.	9,359,000	13,111,000	22,470,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.	27,125,000	5,453,000	32,578,000
Disposal Conveyance, Land	17,000		17,000
Reservoir Storage, Const.	6,596,000	214,000	6,810,000
Reservoir Storage, Land	318,000		318,000
Land Application, Const.	56,765,000	9,023,000	65,788,000
Land Application, Land	11,636,000		11,636,000
Land Application, Revenue		<17,301,000>	<17,301,000>
Subtotal w/o solids, construction	112,419,000	11,586,000	124,005,000
Subtotal w/o solids, land	11,952,000		11,952,000
Total w/o solids	124,371,000	11,586,000	135,957,000
Solids Facilities, Const.	1,980,000	5,835,000	7,815,000
Solids Facilities, Land	143,000		143,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	114,399,000	17,421,000	131,820,000
SUBTOTAL incl. solids, LAND	12,095,000		12,095,000
TOTAL incl. solids	126,494,000	17,421,000	143,915,000

Notes:

APPENDIX IIIn
ELEMENT COST SUMMARY, 1983 STD.

Alternative: (NS+SV)-li Subalternative: ____________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	12,738,000	1,211,000	13,949,000
Service Area Conveyance, Land	4,000		4,000
Treatment Facilities, Const.	4,015,000	1,305,000	5,320,000
Treatment Facilities, Land	259,000		259,000
Disposal Conveyance, Const.	1,417,000	255,000	1,672,000
Disposal Conveyance, Land	1,000		1,000
Reservoir Storage, Const.	4,049,000	92,000	4,141,000
Reservoir Storage, Land	294,000		294,000
Land Application, Const.	16,120,000	2,388,000	18,508,000
Land Application, Land	2,326,000		2,326,000
Land Application, Revenue		<4,819,000>	<4,819,000>
Subtotal w/o solids, construction	38,339,000	432,000	38,771,000
Subtotal w/o solids, land	2,884,000		2,884,000
Total w/o solids	41,223,000	432,000	41,655,000
Solids Facilities, Const.		85,000	85,000
Solids Facilities, Land	2,000		2,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	38,339,000	517,000	38,856,000
SUBTOTAL incl. solids, LAND	2,886,000		2,886,000
TOTAL incl. solids	41,225,000	517,000	41,742,000

Notes:

APPENDIX [illegible]
ELEMENT COST SUMMARY, [illegible] STD.

Alternative: [illegible] Subalternative: ______

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.			
Service Area Conveyance, Land			
Treatment Facilities, Const.	12,087,000	21,950,000	
Treatment Facilities, Land	<8,000>		<8,[illegible]>
Disposal Conveyance, Const.			
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	12,087,000	21,950,000	34,037,000
Subtotal w/o solids, land	<8,000>		<8,000>
Total w/o solids	12,079,000	21,950,000	34,[illegible]
Solids Facilities, Const.	<[illegible]>	5,944,000	5,721,[illegible]
Solids Facilities, Land	125,000		125,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	[illegible]	[illegible]	[illegible]
SUBTOTAL incl. solids, LAND	11[illegible]		11[illegible]
TOTAL incl. solids	[illegible]	[illegible]	[illegible]

Notes:

APPENDIX [illegible]

ELEMENT COST SUMMARY, [illegible] STD.

Alternative: [illegible] Subalternative: ______

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.			
Service Area Conveyance, Land			
Treatment Facilities, Const.	<143,000>	12,787,000	12,64[illegible]
Treatment Facilities, Land	<32,000>		<32,000>
Disposal Conveyance, Const.	5,574,000	778,000	6,352,000
Disposal Conveyance, Land	2,000		2,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.	2,737,000	944,000	3,681,000
Land Application, Land	329,000		329,000
Land Application, Revenue		< >	
Subtotal w/o solids, construction	8,165,000	14,509,000	22,674,000
Subtotal w/o solids, land	299,000		299,000
Total w/o solids	8,464,000	14,509,000	22,973,000
Solids Facilities, Const.	<223,000>	5,854,000	5,631,000
Solids Facilities, Land	43,000		43,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	7,[illegible]2,000	20,363,000	28,305,000
SUBTOTAL incl. solids, LAND	342,000		342,000
TOTAL incl. solids	8,284,000	20,363,000	28,647,000

Notes:

APPENDIX IVc
ELEMENT COST SUMMARY, 1985 STD.

Alternative: C-iii/li Subalternative: ______

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	____	____	____
Service Area Conveyance, Land	____		____
Treatment Facilities, Const.	<146,000>	12,787,000	12,641,000
Treatment Facilities, Land	<32,000>		<32,000>
Disposal Conveyance, Const.	7,809,000	1,411,000	9,220,000
Disposal Conveyance, Land	5,000		5,000
Reservoir Storage, Const.	2,074,000	72,000	2,146,000
Reservoir Storage, Land	97,000		97,000
Land Application, Const.	15,798,000	2,285,000	18,083,000
Land Application, Land	3,120,000		3,120,000
Land Application, Revenue		<4,374,000>	<4,374,000>
Subtotal w/o solids, construction	25,535,000	12,181,000	37,716,000
Subtotal w/o solids, land	3,190,000		3,190,000
Total w/o solids	28,725,000	12,181,000	40,906,000
Solids Facilities, Const.	<223,000>	5,854,000	5,631,000
Solids Facilities, Land	43,000		43,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	25,312,000	18,035,000	43,347,000
SUBTOTAL incl. solids, LAND	3,233,000		3,233,000
TOTAL incl. solids	28,545,000	18,035,000	46,580,000

Notes:

APPENDIX IVd

ELEMENT COST SUMMARY, 1985 STD.

Alternative: (C+NS)-[illegible] Subalternative: ____________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	4,769,000	526,000	5,295,000
Service Area Conveyance, Land	5,000		5,000
Treatment Facilities, Const.	13,348,000	23,158,000	36,506,000
Treatment Facilities, Land	<7000>		<7,000>
Disposal Conveyance, Const.	____	____	____
Disposal Conveyance, Land	____		____
Reservoir Storage, Const.	____	____	____
Reservoir Storage, Land	____		____
Land Application, Const.	____	____	____
Land Application, Land	____		____
Land Application, Revenue		< >	
Subtotal w/o solids, construction	18,117,000	23,684,000	41,801,000
Subtotal w/o solids, land	<2,000>		<2,000>
Total w/o solids	18,115,000	23,684,000	41,799,000
Solids Facilities, Const.	<223,000>	6,135,000	5,912,000
Solids Facilities, Land	141,000		141,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	17,894,000	29,819,000	47,713,000
SUBTOTAL incl. solids, LAND	139,000		139,000
TOTAL incl. solids	18,033,000	29,819,000	47,852,000

Notes:

APPENDIX IV-2
ELEMENT COST SUMMARY, 1975 STD.

Alternative: (C+NS)-ww/lp Subalternative: ____________________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	4,769,000	526,000	5,295,000
Service Area Conveyance, Land	5,000		5,000
Treatment Facilities, Const.	<146,000>	13,008,000	12,862,000
Treatment Facilities, Land	<32,000>		<32,000>
Disposal Conveyance, Const.	5,635,000	813,000	6,448,000
Disposal Conveyance, Land	2,000		2,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.	3,204,000	1,057,000	4,261,000
Land Application, Land	400,000		400,000
Land Application, Revenue		< >	
Subtotal w/o solids, construction	13,462,000	15,404,000	28,866,000
Subtotal w/o solids, land	375,000		375,000
Total w/o solids	13,837,000	15,404,000	29,241,000
Solids Facilities, Const.	<223,000>	6,028,000	5,805,000
Solids Facilities, Land	128,000		128,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	13,239,000	21,432,000	34,671,[illegible]
SUBTOTAL incl. solids, LAND	503,000		503,[illegible]
TOTAL incl. solids	13,742,000	21,432,000	35,174,[illegible]

Notes:

APPENDIX IV L
ELEMENT COST SUMMARY, 1985 STD.

Alternative: (C+NS) sw/li Subalternative: ____________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	4,769,000	526,000	5,295,000
Service Area Conveyance, Land	5,000		5,000
Treatment Facilities, Const.	<146,000>	13,008,000	12,862,000
Treatment Facilities, Land	<32,000>		<32,000>
Disposal Conveyance, Const.	8,748,000	1,567,000	10,315,000
Disposal Conveyance, Land	6,000		6,000
Reservoir Storage, Const.	2,197,000	72,000	2,269,000
Reservoir Storage, Land	102,000		102,000
Land Application, Const.	18,150,000	2,633,000	20,783,000
Land Application, Land	3,604,000		3,604,000
Land Application, Revenue		<5,047,000>	<5,047,000>
Subtotal w/o solids, construction	33,718,000	12,759,000	46,477,000
Subtotal w/o solids, land	3,685,000		3,685,000
Total w/o solids	37,403,000	12,759,000	50,162,000
Solids Facilities, Const.	<223,000>	6,028,000	5,805,000
Solids Facilities, Land	128,000		128,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	33,495,000	18,787,000	52,282,000
SUBTOTAL incl. solids, LAND	3,813,000		3,813,000
TOTAL incl. solids	37,308,000	18,787,000	56,095,000

Notes:

APPENDIX IV g
ELEMENT COST SUMMARY, 1985 STD.

Alternative: (C+SU) - sw Subalternative:

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	7,806,000	561,000	8,367,000
Service Area Conveyance, Land	2,000		2,000
Treatment Facilities, Const.	21,460,000	26,553,000	48,013,000
Treatment Facilities, Land	<3,000>		<3,000>
Disposal Conveyance, Const.			
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	29,266,000	27,114,000	56,380,000
Subtotal w/o solids, land	<1000>		<1,000>
Total w/o solids	29,265,000	27,114,000	56,379,000
Solids Facilities, Const.	2,084,000	7,101,000	9,185,000
Solids Facilities, Land	158,000		158,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	31,350,000	34,215,000	65,565,000
SUBTOTAL incl. solids, LAND	157,000		157,000
TOTAL incl. solids	31,507,000	34,215,000	65,722,000

Notes:

APPENDIX IV h

ELEMENT COST SUMMARY, 1985 STD.

Alternative: (C+SU)-aw/lp Subalternative: ______________________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	7,806,000	561,000	8,367,000
Service Area Conveyance, Land	2,000		2,000
Treatment Facilities, Const.	6,518,000	15,156,000	21,674,000
Treatment Facilities, Land	<32,000>		<32,000>
Disposal Conveyance, Const.	6,322,000	906,000	7,228,000
Disposal Conveyance, Land	2,000		2,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.	3,544,000	1,125,000	4,669,000
Land Application, Land	438,000		438,000
Land Application, Revenue		< >	
Subtotal w/o solids, construction	24,190,000	17,748,000	41,938,000
Subtotal w/o solids, land	410,000		410,000
Total w/o solids	24,600,000	17,748,000	42,348,000
Solids Facilities, Const.	2,083,000	6,995,000	9,078,000
Solids Facilities, Land	54,000		54,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	26,273,000	24,743,000	51,016,000
SUBTOTAL incl. solids, LAND	464,000		464,[illegible]
TOTAL incl. solids	26,737,000	24,743,000	51,480,000

Notes:

APPENDIX IV i

ELEMENT COST SUMMARY, 1985 STD.

Alternative: (C+SU) cw/le Subalternative: ____________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	7,806,000	561,000	8,367,000
Service Area Conveyance, Land	2,000		2,000
Treatment Facilities, Const.	6,518,000	15,156,000	21,674,000
Treatment Facilities, Land	<32,000>		<32,000>
Disposal Conveyance, Const.	9,454,000	1,679,000	11,133,000
Disposal Conveyance, Land	6,000		6,000
Reservoir Storage, Const.	2,276,000	72,000	2,348,000
Reservoir Storage, Land	107,000		107,000
Land Application, Const.	20,225,000	2,935,000	23,163,000
Land Application, Land	7,045,000		7,045,000
Land Application, Revenue		<5,627,000>	<5,627,000>
Subtotal w/o solids, construction	46,279,000	14,199,0	1,058,000
Subtotal w/o solids, land	7,128,000		7,128,000
Total w/o solids	53,407,000	14,199,000	,186,000
Solids Facilities, Const.	2,083,000	6,995,000	9,078,000
Solids Facilities, Land	54,000		54,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	48,362,000	21,744,000	70,136,000
SUBTOTAL incl. solids, LAND	7,128,000		7,182,000
TOTAL incl. solids	55,544,000	21,744,000	77,318,000

Notes:

APPENDIX IV-j

ELEMENT COST SUMMARY, 1985 STD.

Alternative: C+NS+SU)-aw Subalternative: ______________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	12,574,000	1,086,000	13,660,000
Service Area Conveyance, Land	7,000		7,000
Treatment Facilities, Const.	26,311,000	28,998,000	55,309,000
Treatment Facilities, Land	<2,000>		<2,000>
Disposal Conveyance, Const.			
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	38,885,000	30,084,000	68,969,000
Subtotal w/o solids, land	5,000		5,000
Total w/o solids	38,890,000	30,084,000	68,974,000
Solids Facilities, Const.	3,346,000	7,739,000	11,085,000
Solids Facilities, Land	179,000		174,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	42,231,000	37,823,000	80,054,000
SUBTOTAL incl. solids, LAND	179,000		179,000
TOTAL incl. solids	42,410,000	37,823,000	80,233,000

Notes:

APPENDIX IV K
ELEMENT COST SUMMARY, 1985 STD.

Alternative: (C+NS+SV)-sw/la Subalternative: ______

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	12,574,000	1,086,000	13,660,000
Service Area Conveyance, Land	7,000		7,000
Treatment Facilities, Const.	10,136,000	16,574,000	26,710,000
Treatment Facilities, Land	<32,000>		<32,000>
Disposal Conveyance, Const.	6,687,000	997,000	7,684,000
Disposal Conveyance, Land	3,000		3,000
Reservoir Storage, Const.			
Reservoir Storage, Land	4,003,000		
Land Application, Const.	508,000	1,242,000	5,245,000
Land Application, Land			508,000
Land Application, Revenue		< >	
Subtotal w/o solids, construction	33,400,000	19,899,000	53,299,000
Subtotal w/o solids, land	486,000		486,000
Total w/o solids	33,886,000	19,899,000	53,785,000
Solids Facilities, Const.	3,346,000	7,649,000	10,995,000
Solids Facilities, Land	59,000		59,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	36,746,000	27,548,000	64,294,000
SUBTOTAL incl. solids, LAND	545,000		545,000
TOTAL incl. solids	37,291,000	27,548,000	64,839,000

Notes:

APPENDIX IV-Q

ELEMENT COST SUMMARY, 1985 STD.

Alternative: (C+NS+SU)-w/li Subalternative: ____________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	12,574,000	1,086,000	13,660,000
Service Area Conveyance, Land	7,000		7,000
Treatment Facilities, Const.	10,136,000	16,574,000	26,710,000
Treatment Facilities, Land	<32,000>		<32,000>
Disposal Conveyance, Const.	10,012,000	1,854,000	11,866,000
Disposal Conveyance, Land	6,000		6,000
Reservoir Storage, Const.	2,394,000	72,000	2,466,000
Reservoir Storage, Land	114,000		114,000
Land Application, Const.	22,773,000	3,287,000	26,060,000
Land Application, Land	4,500,000		4,500,000
Land Application, Revenue		<6,300,000>	<6,300,000>
Subtotal w/o solids, construction	57,889,000	16,573,000	74,462,000
Subtotal w/o solids, land	4,595,000		4,595,000
Total w/o solids	62,484,000	16,573,000	79,057,000
Solids Facilities, Const.	3,346,000	7,649,000	10,995,000
Solids Facilities, Land	59,000		59,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	61,235,000	24,222,000	85,457,000
SUBTOTAL incl. solids, LAND	4,654,000		4,654,000
TOTAL incl. solids	65,889,000	24,222,000	90,111,000

Notes:

APPENDIX II m
ELEMENT COST SUMMARY, 1985 STD.

Alternative: N5-sw Subalternative:

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	381,000	48,000	429,000
Service Area Conveyance, Land	1,000		1,000
Treatment Facilities, Const.	6,712,000	3,953,000	10,665,000
Treatment Facilities, Land	59,000		59,000
Disposal Conveyance, Const.	2,062,000	249,000	2,311,000
Disposal Conveyance, Land	13,000		13,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	9,155,000	4,250,000	13,405,000
Subtotal w/o solids, land	73,000		73,000
Total w/o solids	9,288,000	4,250,000	13,478,000
Solids Facilities, Const.	1,175,000	1,079,000	2,254,000
Solids Facilities, Land	15,000		15,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	10,330,000	5,329,000	15,659,000
SUBTOTAL incl. solids, LAND	88,000		88,000
TOTAL incl. solids	10,418,000	5,329,000	15,747,000

Notes:

APPENDIX IVn

ELEMENT COST SUMMARY, 1985 STD.

Alternative: NS-ow/lp Subalternative: ______

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	381,000	48,000	429,000
Service Area Conveyance, Land	1,000		1,000
Treatment Facilities, Const.	5,138,000	2,631,000	7,769,000
Treatment Facilities, Land	52,000		52,000
Disposal Conveyance, Const.	11,000	272,000	2,814,000
Disposal Conveyance, Land			11,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.	467,000	246,000	713,000
Land Application, Land	71,000		71,000
Land Application, Revenue		< >	
Subtotal w/o solids, construction	8,528,000	3,197,000	11,725,000
Subtotal w/o solids, land	135,000		135,000
Total w/o solids	8,663,000	3,197,000	11,860,000
Solids Facilities, Const.	982,000	1,077,000	2,059,000
Solids Facilities, Land	14,000		14,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	9,510,000	4,274,000	13,784,000
SUBTOTAL incl. solids, LAND	149,000		149,000
TOTAL incl. solids	9,659,000	4,274,000	13,933,000

Notes:

APPENDIX IV-o

ELEMENT COST SUMMARY, 1985 STD.

Alternative: NS-aw/li Subalternative: ____________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	1,712,000	237,000	1,949,000
Service Area Conveyance, Land	1,000		1,000
Treatment Facilities, Const.	3,982,000	2,099,000	6,081,000
Treatment Facilities, Land	39,000		39,000
Disposal Conveyance, Const.	2,602,000	231,000	2,833,000
Disposal Conveyance, Land	12,000		12,000
Reservoir Storage, Const.	753,000	31,000	784,000
Reservoir Storage, Land	78,000		78,000
Land Application, Const.	2,518,000	335,000	2,853,000
Land Application, Land	346,000		346,000
Land Application, Revenue		<671,000>	<671,000>
Subtotal w/o solids, construction	11,567,000	2,262,000	13,829,000
Subtotal w/o solids, land	476,000		476,000
Total w/o solids	12,043,000	2,262,000	14,305,000
Solids Facilities, Const.	982,000	1,077,000	2,059,000
Solids Facilities, Land	14,000		14,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	12,549,000	3,339,000	15,888,000
SUBTOTAL incl. solids, LAND	490,000		490,000
TOTAL incl. solids	13,039,000	3,339,000	16,378,000

Notes:

APPENDIX IVp
ELEMENT COST SUMMARY, 1985 STD.

Alternative: SV-sw Subalternative: ______

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.			
Service Area Conveyance, Land			
Treatment Facilities, Const.	10,649,000	7,168,000	17,817,000
Treatment Facilities, Land	40,000		40,000
Disposal Conveyance, Const.	1,547,000	65,000	1,612,000
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		( )	
Subtotal w/o solids, construction	12,196,000	7,233,000	19,429,000
Subtotal w/o solids, land	40,000		40,000
Total w/o solids	12,236,000	7,233,000	19,469,000
Solids Facilities, Const.	1,621,000	1,907,000	3,528,000
Solids Facilities, Land	31,000		31,000
Solids Facilities, Revenue		( )	
SUBTOTAL incl. solids, CONST.	13,817,000	9,140,000	22,957,000
SUBTOTAL incl. solids, LAND	71,000		71,000
TOTAL incl. solids	13,888,000	9,140,000	23,028,000

Notes:

APPENDIX IV q
ELEMENT COST SUMMARY, 1985 STD.

Alternative: SV-sw/lp Subalternative: ____________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.			
Service Area Conveyance, Land			
Treatment Facilities, Const.	8,415,000	4,728,000	13,143,000
Treatment Facilities, Land	36,000		36,000
Disposal Conveyance, Const.	4,571,000	273,000	4,844,000
Disposal Conveyance, Land	2,000		2,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.	799,000	368,000	1,167,000
Land Application, Land	55,000		55,000
Land Application, Revenue		< >	
Subtotal w/o solids, construction	13,785,000	5,369,000	19,154,000
Subtotal w/o solids, land	93,000		93,000
Total w/o solids	13,878,000	5,369,000	19,247,000
Solids Facilities, Const.	1,621,000	1,887,000	3,508,000
Solids Facilities, Land	29,000		29,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	15,406,000	7,256,000	22,662,000
SUBTOTAL incl. solids, LAND	122,000		122,000
TOTAL incl. solids	15,528,000	7,256,000	22,784,000

Notes:

APPENDIX IVr
ELEMENT COST SUMMARY, 1985 STD.

Alternative: SV-sw/li Subalternative: ____________

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	3,227,000	250,000	3,477,000
Service Area Conveyance, Land	1,000		1,000
Treatment Facilities, Const.	6,707,000	3,936,000	10,643,000
Treatment Facilities, Land	26,000		26,000
Disposal Conveyance, Const.	2,158,000	160,000	2,318,000
Disposal Conveyance, Land			
Reservoir Storage, Const.	1,104,000	31,000	1,135,000
Reservoir Storage, Land	105,000		105,000
Land Application, Const.	4,571,000	622,000	5,193,000
Land Application, Land	640,000		640,000
Land Application, Revenue		<1,253,000>	<1,253,000>
Subtotal w/o solids, construction	17,767,000	3,746,000	21,513,000
Subtotal w/o solids, land	772,000		772,000
Total w/o solids	18,539,000	3,746,000	22,285,000
Solids Facilities, Const.	1,621,000	1,887,000	3,508,000
Solids Facilities, Land	29,000		29,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	19,388,000	5,633,000	25,021,000
SUBTOTAL incl. solids, LAND	801,000		801,000
TOTAL incl. solids	20,189,000	5,633,000	25,822,000

Notes:

APPENDIX IV s
ELEMENT COST SUMMARY, 1985 STD.

Alternative: (NS+SV)-SW   Subalternative: ______

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	5,963,000	640,000	6,603,000
Service Area Conveyance, Land	8,000		8,000
Treatment Facilities, Const.	14,891,000	9,640,000	24,531,000
Treatment Facilities, Land	57,000		57,000
Disposal Conveyance, Const.	2,068,000	86,000	2,154,000
Disposal Conveyance, Land			
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.			
Land Application, Land			
Land Application, Revenue		< >	
Subtotal w/o solids, construction	22,922,000	10,366,000	33,288,000
Subtotal w/o solids, land	65,000		65,000
Total w/o solids	22,987,000	10,366,000	33,353,000
Solids Facilities, Const.	2,225,000	2,417,000	4,642,000
Solids Facilities, Land	45,000		45,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	25,147,000	12,783,000	37,93[illegible],000
SUBTOTAL incl. solids, LAND	110,000		110,000
TOTAL incl. solids	25,257,000	12,783,000	38,040,000

Notes:

APPENDIX Va

ELEMENT COST SUMMARY, 1985 STD.

Alternative: (C+NS)-sw/lp Subalternative: With Nitrification-Denitrification Pretreatment to Percolation

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	4,769,000	526,000	5,295,000
Service Area Conveyance, Land	5,000		5,000
Treatment Facilities, Const.	4,846,000	14,990,000	19,836,000
Treatment Facilities, Land	<21,000>		<21,000>
Disposal Conveyance, Const.	5,635,000	813,000	6,448,000
Disposal Conveyance, Land	2,000		2,000
Reservoir Storage, Const.			
Reservoir Storage, Land			
Land Application, Const.	3,204,000	1,057,000	4,261,000
Land Application, Land	400,000		400,000
Land Application, Revenue		< >	
Subtotal w/o solids, construction	18,454,000	17,386,000	35,840,000
Subtotal w/o solids, land	386,000		386,000
Total w/o solids	18,840,000	17,386,000	36,226,000
Solids Facilities, Const.	<223,000>	6,028,000	5,805,000
Solids Facilities, Land	128,000		128,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	18,231,000	23,414,000	41,645,000
SUBTOTAL incl. solids, LAND	514,000		514,000
TOTAL incl. solids	18,745,000	23,414,000	42,159,000

Notes:

APPENDIX Vb
ELEMENT COST SUMMARY, 1983 STD.

Alternative: (C+NS)-li Subalternative: Primary Pretreatment to Prufer

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	4,769,000	526,000	5,295,000
Service Area Conveyance, Land	5,000		5,000
Treatment Facilities, Const.	<434,000>	6,220,000	5,786,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.	23,704,000	4,604,000	28,308,000
Disposal Conveyance, Land	16,000		16,000
Reservoir Storage, Const.	6,025,000	214,000	6,239,000
Reservoir Storage, Land	285,000		285,000
Land Application, Const.	45,830,000	7,293,000	53,123,000
Land Application, Land	9,399,000		9,399,000
Land Application, Revenue		<13,951,000>	<13,951,000>
Subtotal w/o solids, construction	79,894,000	4,906,000	84,800,000
Subtotal w/o solids, land	9,679,000		9,679,000
Total w/o solids	89,573,000	4,906,000	94,479,000
Solids Facilities, Const.	<223,000>	5,295,000	5,072,000
Solids Facilities, Land	79,000		79,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	79,671,000	10,201,000	89,872,000
SUBTOTAL incl. solids, LAND	9,758,000		9,758,000
TOTAL incl. solids	89,429,000	10,201,000	99,630,000

Notes:

APPENDIX V C

ELEMENT COST SUMMARY, 1983 STD.

Alternative: C-li-sw Subalternative: Summer to Old Trails winter to sw.

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.			
Service Area Conveyance, Land			
Treatment Facilities, Const.	<612,000>	10,247,000	9,635,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.	4,756,000	2,276,000	7,032,000
Disposal Conveyance, Land	2,000		2,000
Reservoir Storage, Const.	1,732,000	127,000	1,859,000
Reservoir Storage, Land	121,000		121,000
Land Application, Const.	30,271,000	5,113,000	35,384,000
Land Application, Land	2,307,000		2,307,000
Land Application, Revenue		<6,013,000>	<6,013,000>
Subtotal w/o solids, construction	36,147,000	11,750,000	47,897,000
Subtotal w/o solids, land	2,404,000		2,404000
Total w/o solids	38,551,000	11,750,000	50,301,000
Solids Facilities, Const.	<223,000>	4,438,000	4,215,000
Solids Facilities, Land	103,000		103,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	35,924,000	16,188,000	52,112,000
SUBTOTAL incl. solids, LAND	2,507,000		2,507,000
TOTAL incl. solids	38,431,000	16,188,000	54,619,000

Notes:

APPENDIX V d

ELEMENT COST SUMMARY, 1983 STD.

Alternative: (C+NS)-li-SW Subalternative: Summer to Old Trails / Winter to SW

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	4,769,000	526,000	5,295,000
Service Area Conveyance, Land	5,000		5,000
Treatment Facilities, Const.	<612,000>	10,299,000	9,687,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.	5,303,000	2,526,000	7,829,000
Disposal Conveyance, Land	2,000		2,000
Reservoir Storage, Const.	1,830,000	127,000	1,957,000
Reservoir Storage, Land	127,000		127,000
Land Application, Const.	34,797,000	5,721,000	40,518,000
Land Application, Land	2,588,000		2,588,000
Land Application, Revenue		<6,735,000>	<6,735,000>
Subtotal w/o solids, construction	46,087,000	12,464,000	58,551,000
Subtotal w/o solids, land	2,696,000		2,696,000
Total w/o solids	48,783,000	12,464,000	61,247,000
Solids Facilities, Const.	<223,000>	4,595,000	4,372,000
Solids Facilities, Land	115,000		115,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	45,864,000	17,059,000	62,923,000
SUBTOTAL incl. solids, LAND	2,811,000		2,811,000
TOTAL incl. solids	48,675,000	17,059,000	[illegible]734,000

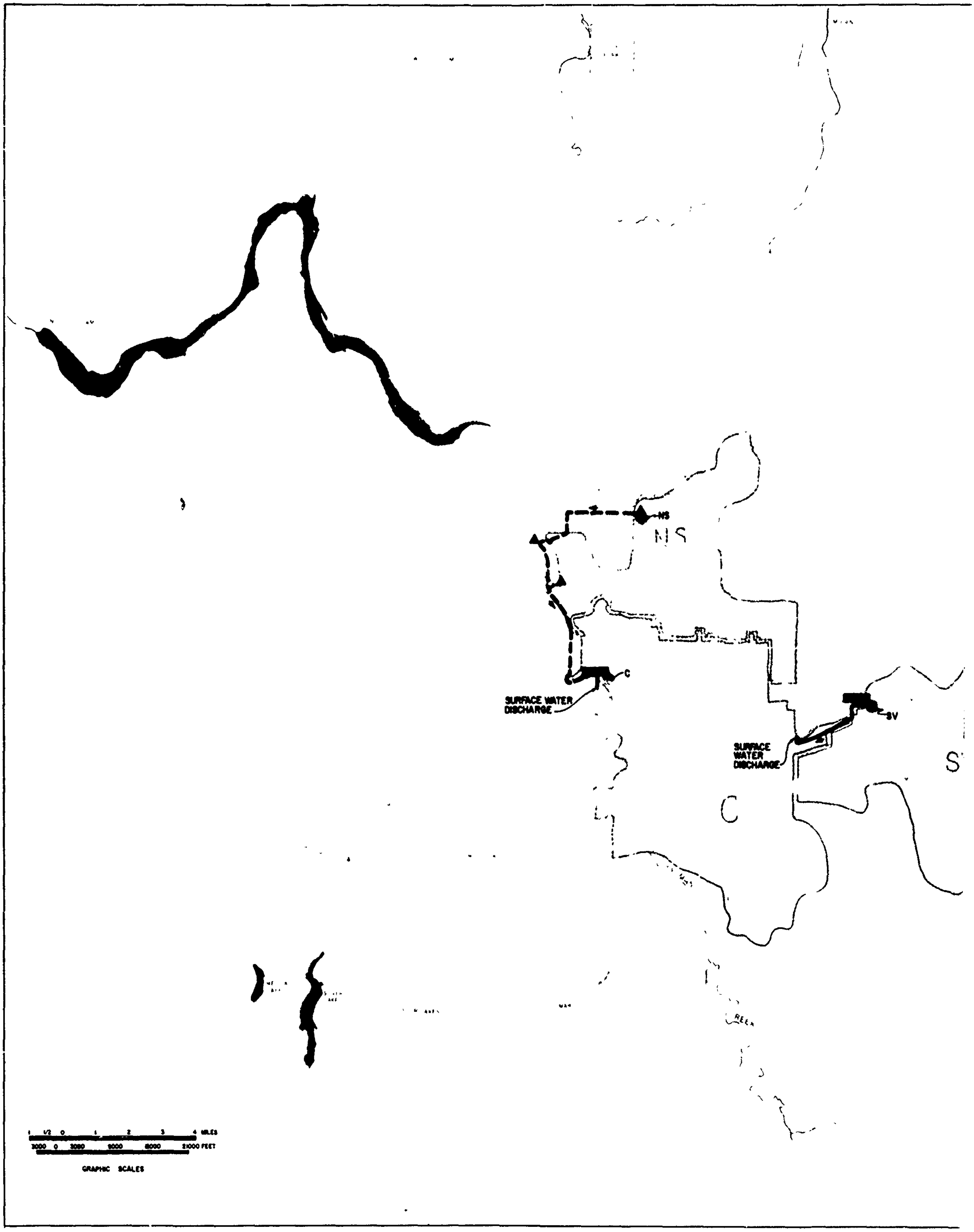
Notes:

APPENDIX Ve
ELEMENT COST SUMMARY, 1983 STD.

Alternative: (C+SV)-Li-sw **Subalternative:** Summer to Old Trails
Winter to sw

	Capital Cost	O & M Cost	Total Cost
Service Area Conveyance, Const.	7,806,000	561,000	8,367,000
Service Area Conveyance, Land	2,000		2,000
Treatment Facilities, Const.	5,832,000	12,020,000	17,852,000
Treatment Facilities, Land	<26,000>		<26,000>
Disposal Conveyance, Const.	5,943,000	2,812,000	8,755,000
Disposal Conveyance, Land	2,000		2,000
Reservoir Storage, Const.	1,960,000	127,000	2,087,000
Reservoir Storage, Land	130,000		130,000
Land Application, Const.	37,343,000	6,469,000	43,812,000
Land Application, Land	2,923,000		2,923,000
Land Application, Revenue		<7,613,000>	<7,613,000>
Subtotal w/o solids, construction	58,884,000	14,376,000	73,260,000
Subtotal w/o solids, land	3,031,000		3,031,000
Total w/o solids	61,915,000	14,376,000	76,291,000
Solids Facilities, Const.	1,201,000	5,346,000	6,547,000
Solids Facilities, Land	130,000		130,000
Solids Facilities, Revenue		< >	
SUBTOTAL incl. solids, CONST.	60,085,000	19,722,000	79,807,000
SUBTOTAL incl. solids, LAND	3,161,000		3,161,000
TOTAL incl. solids	63,246,000	19,722,000	82,968,000

Notes:



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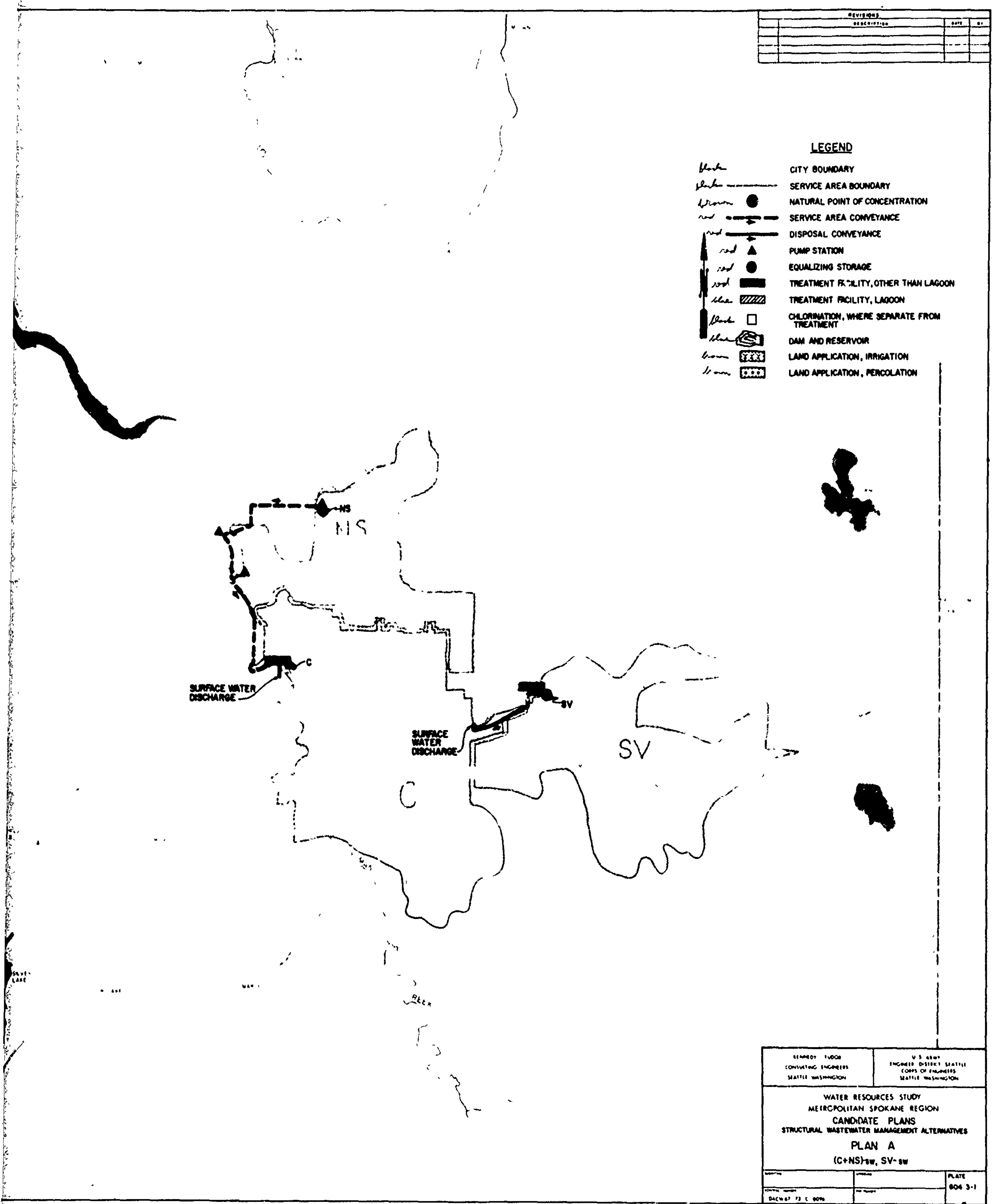
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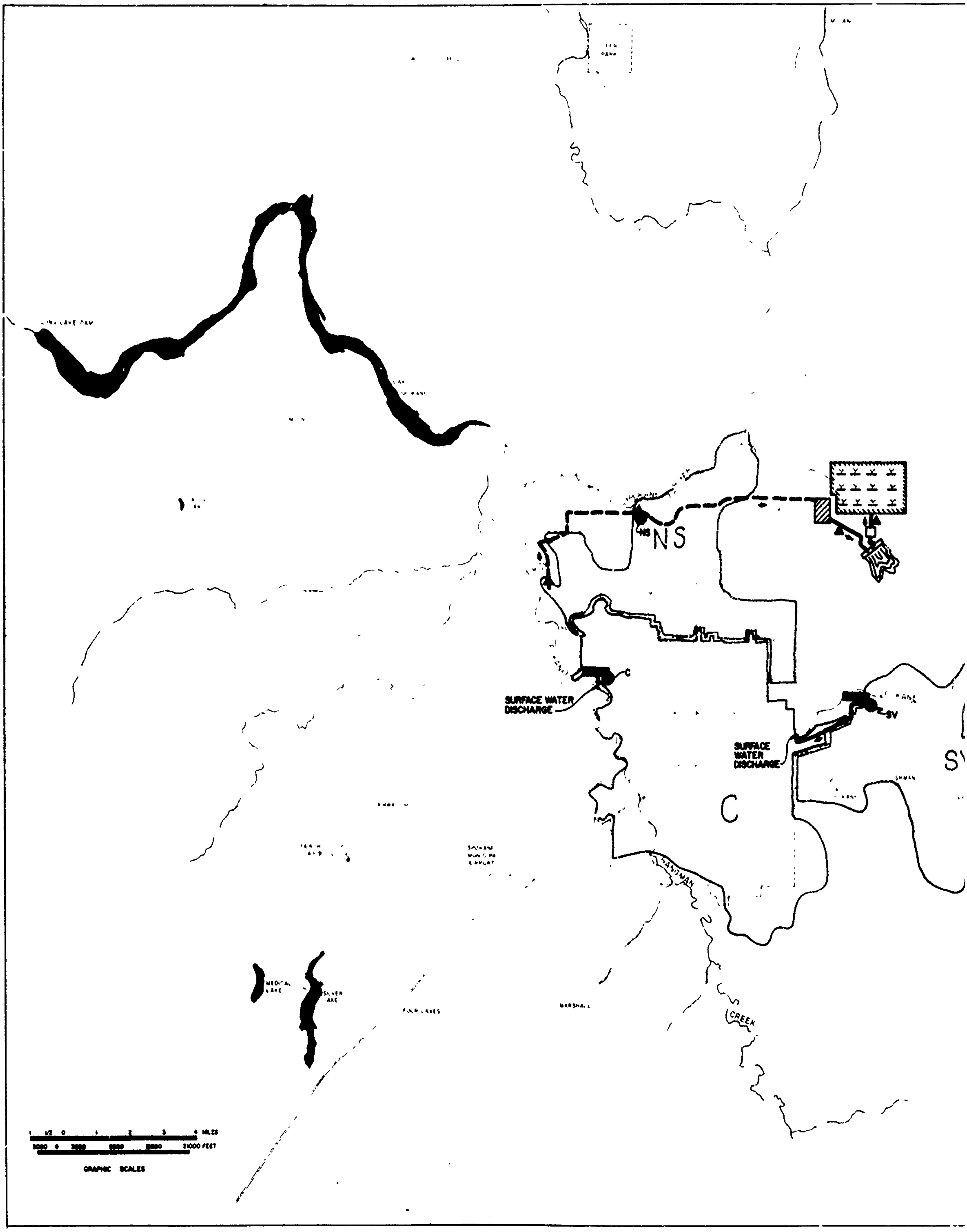
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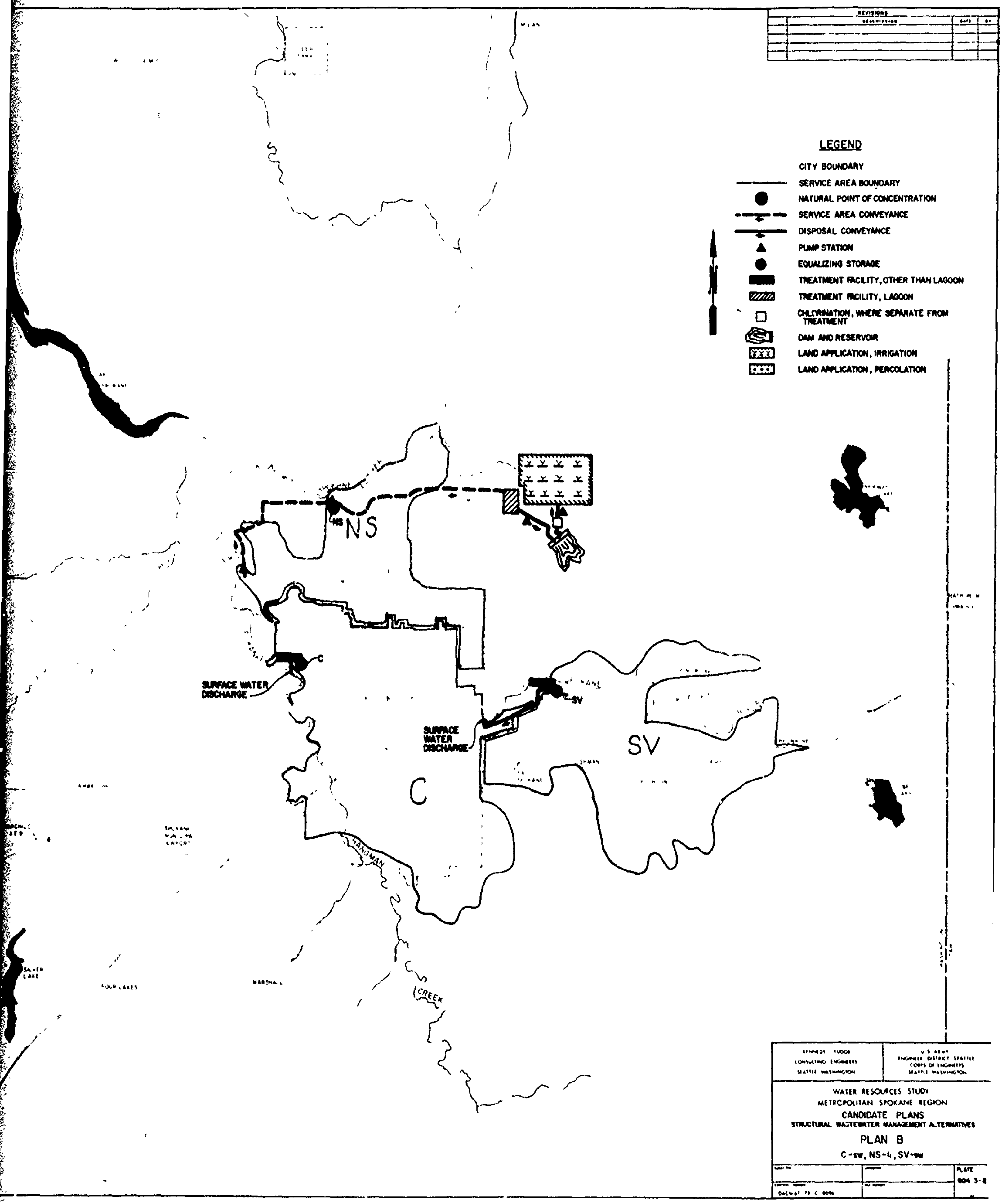
GRAPHIC SCALES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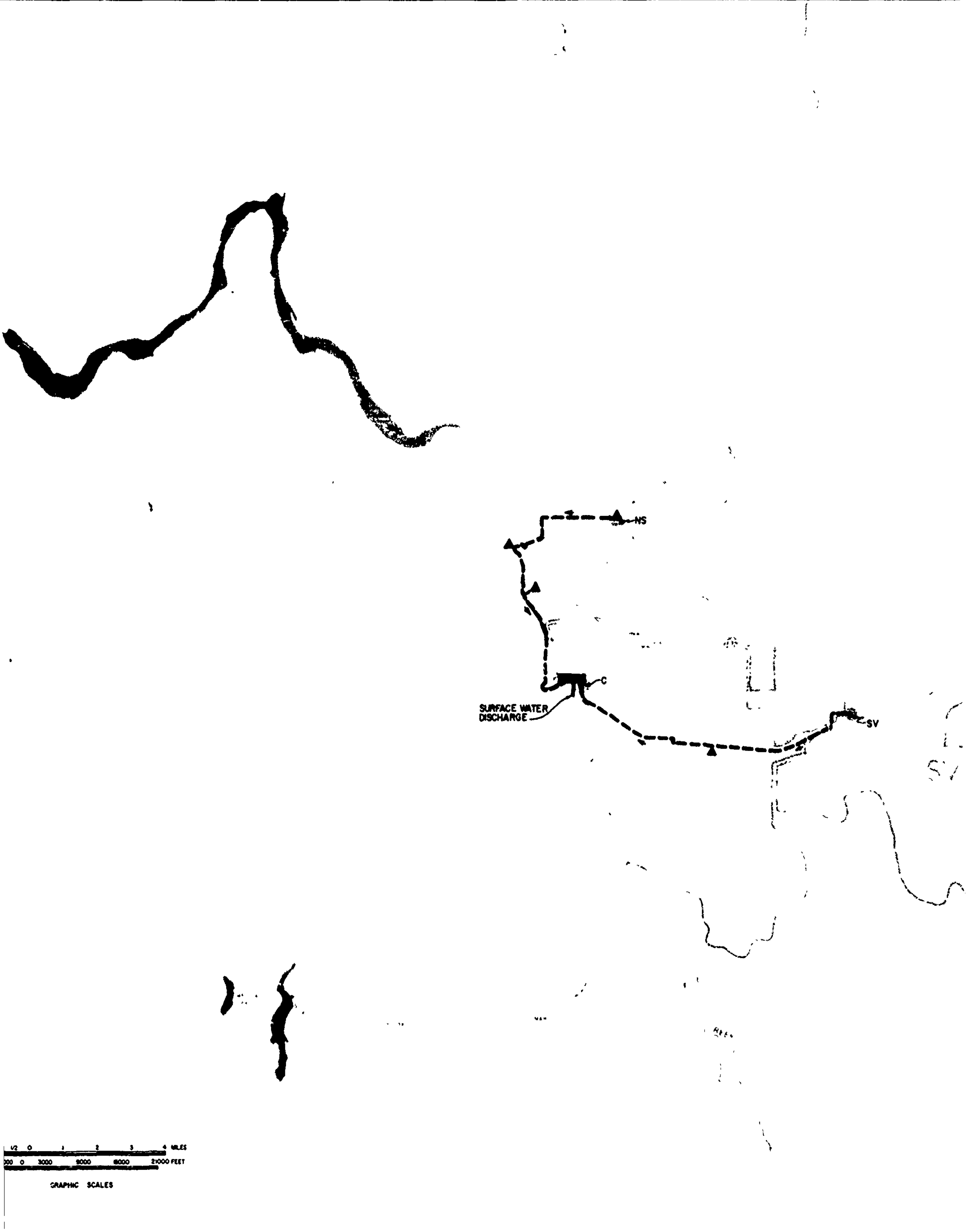
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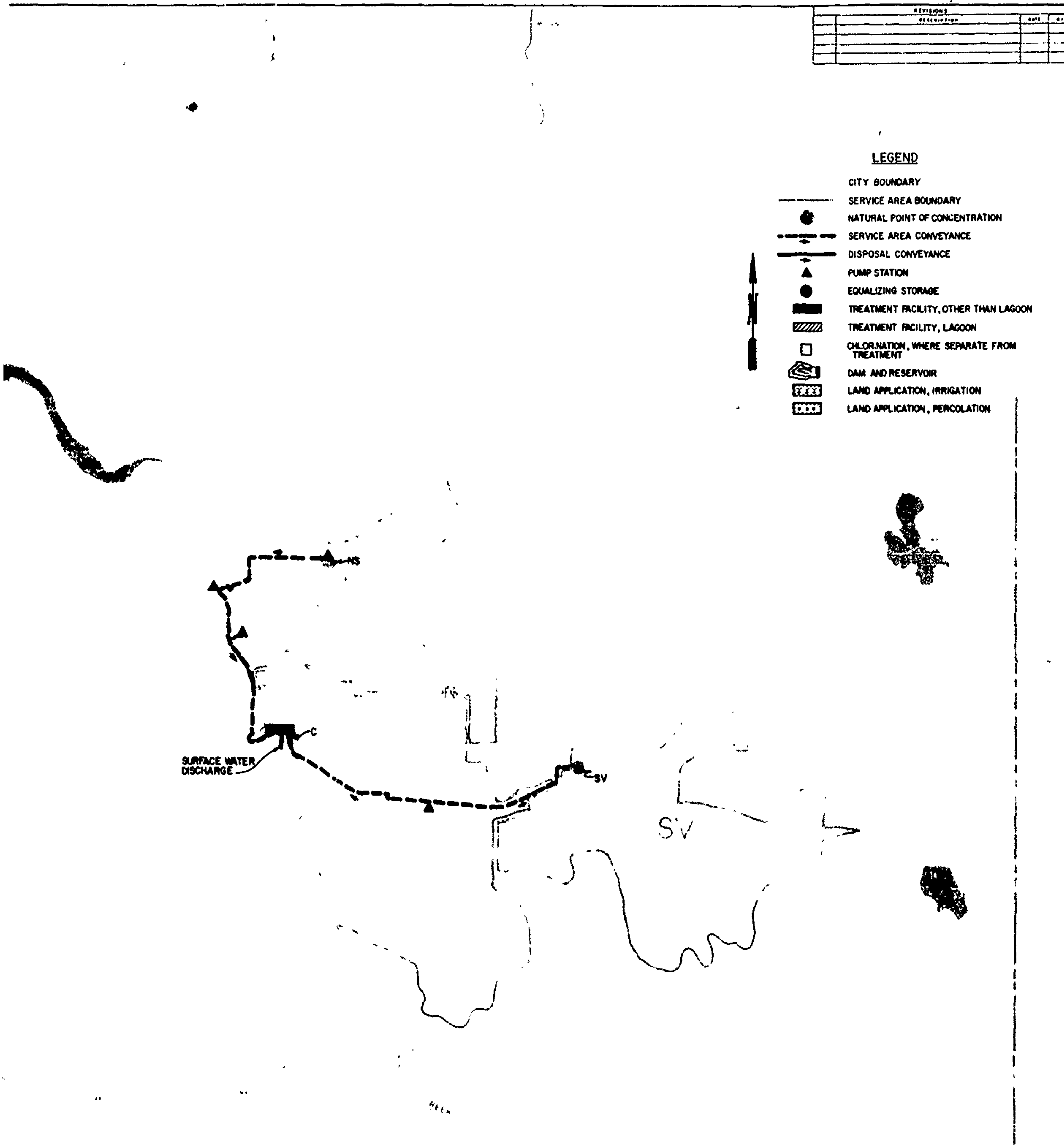

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CONSULTING ENGINEERS
SEATTLE WASHINGTON

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ENGINEER DISTRICT SEATTLE
CORPS OF ENGINEERS
SEATTLE WASHINGTON

WATER RESOURCES STUDY
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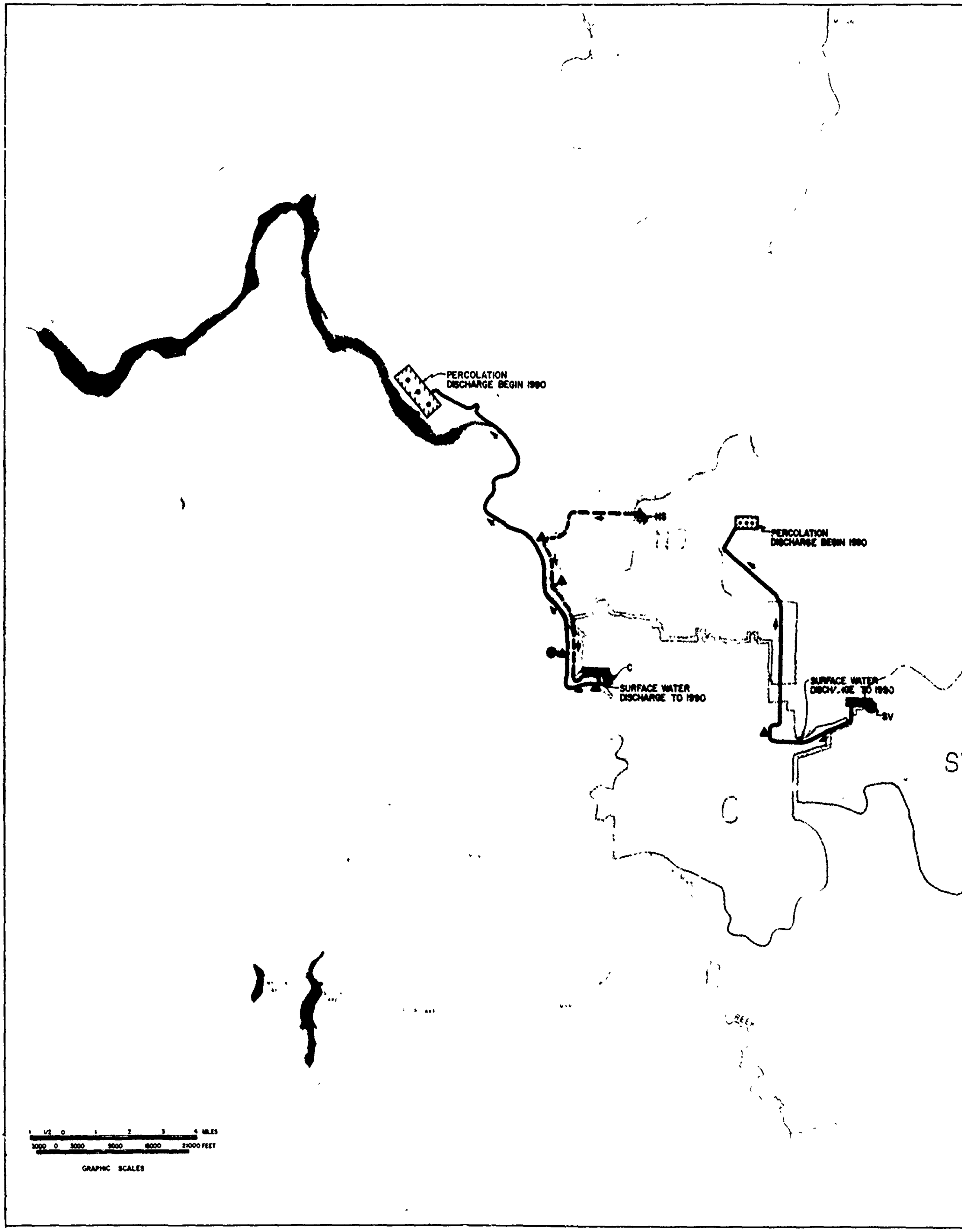
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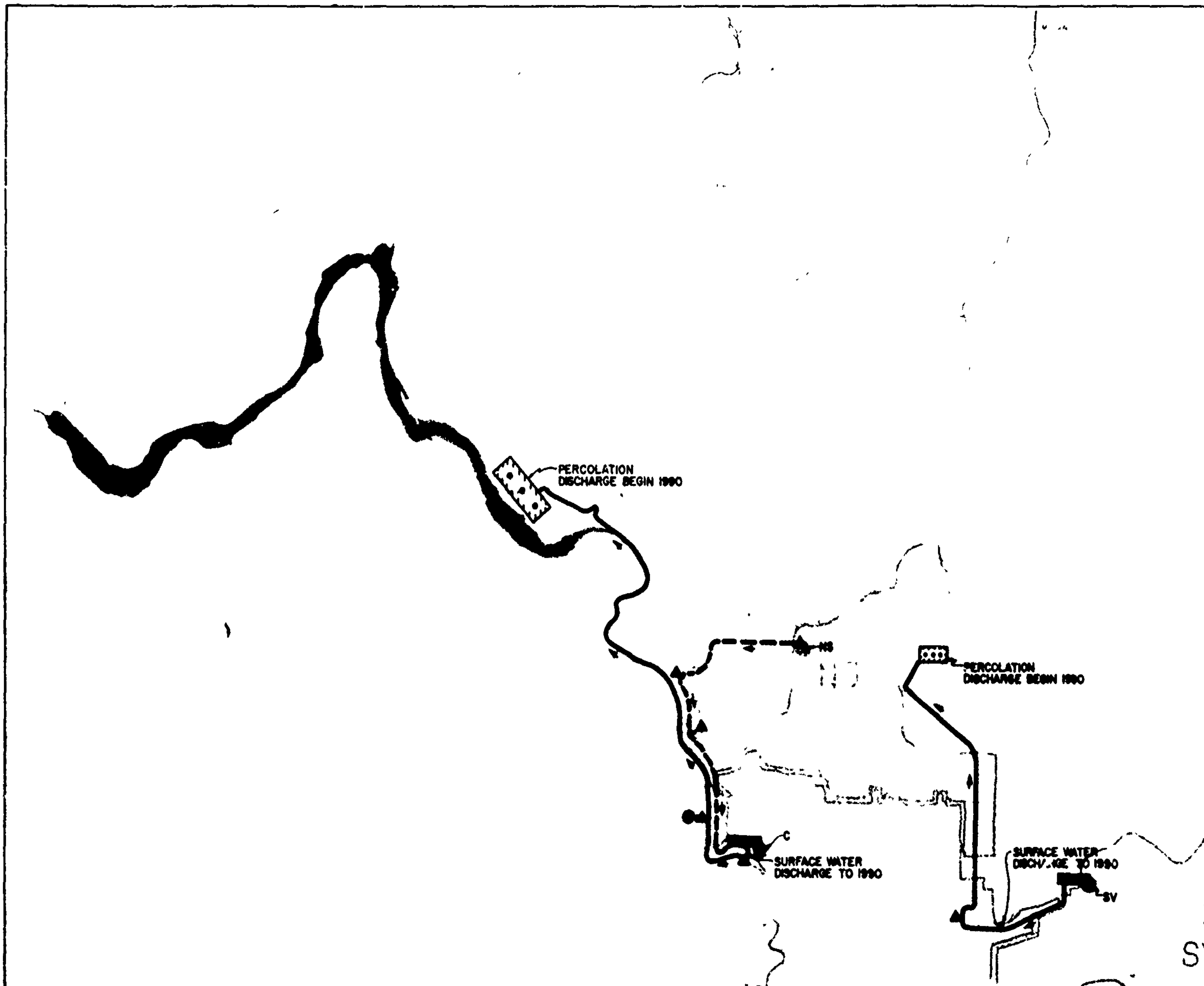

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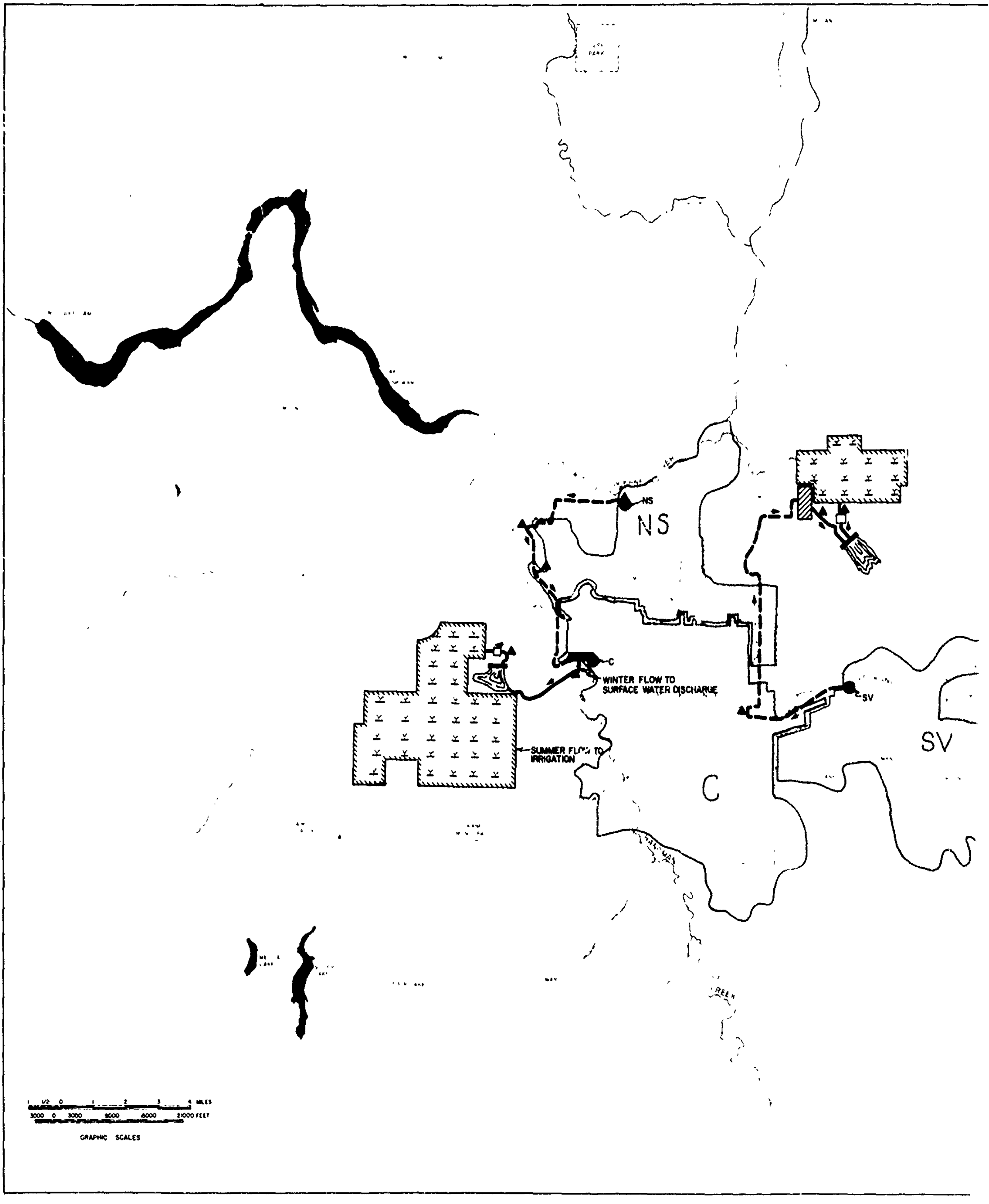

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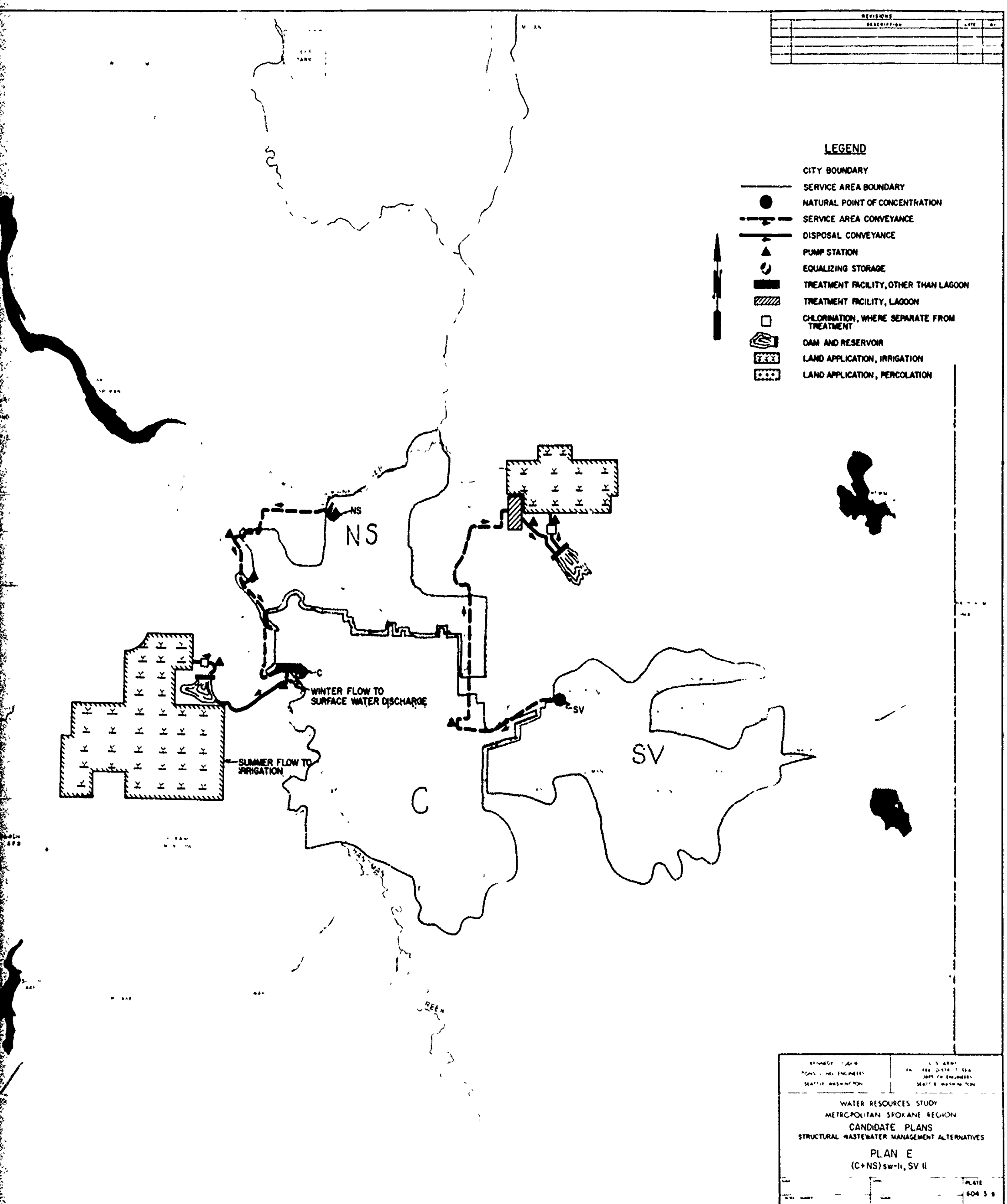
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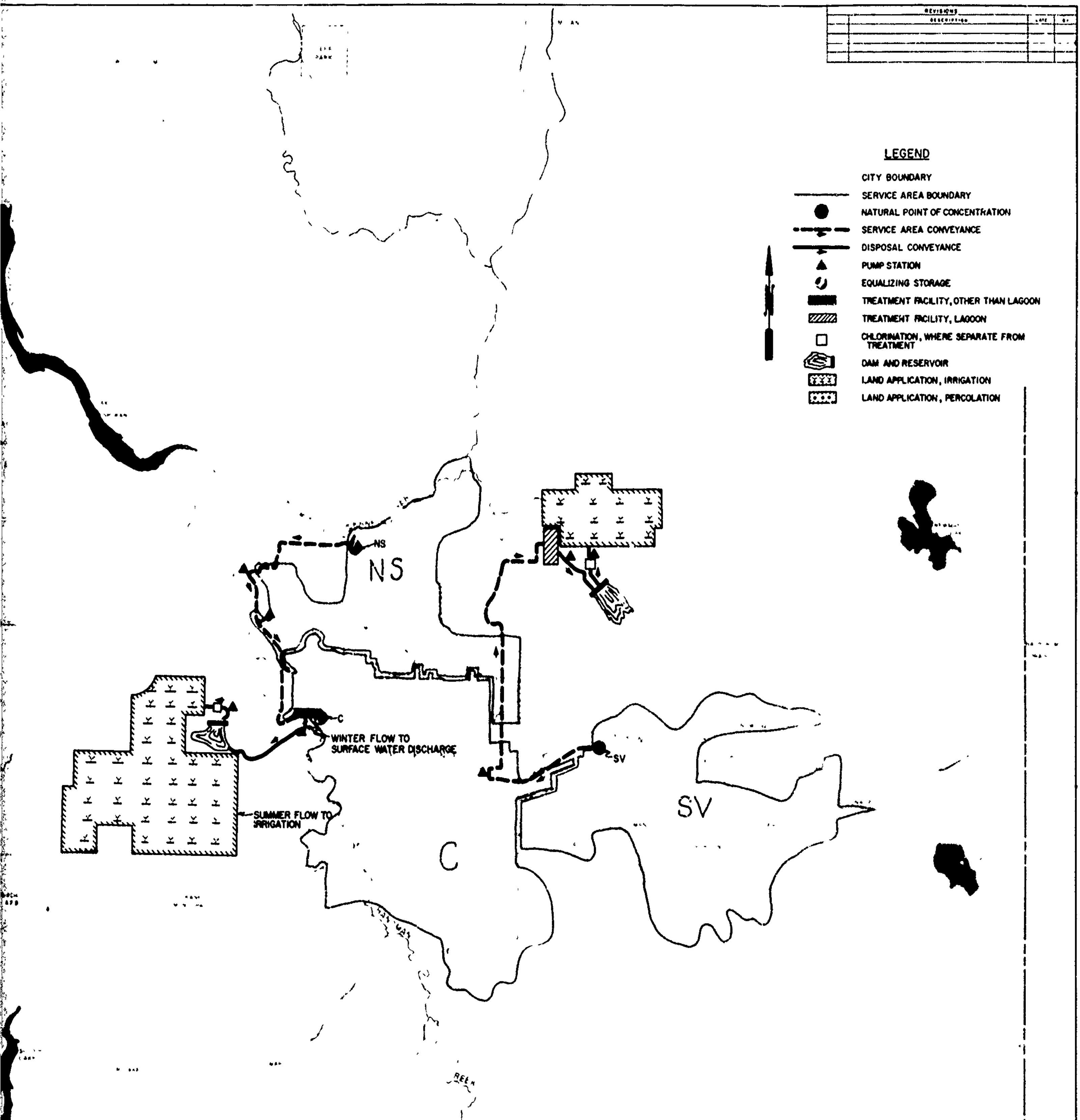

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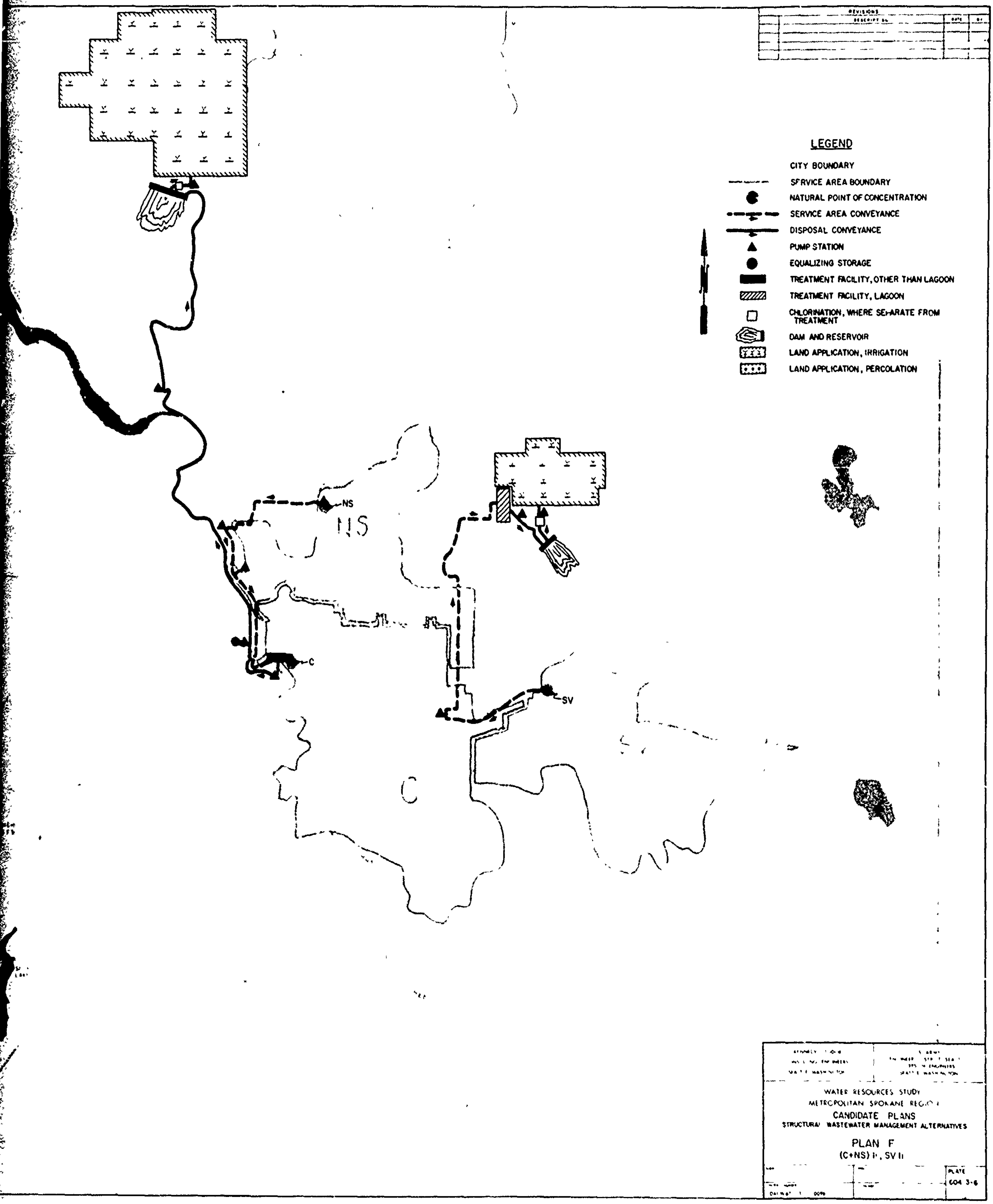
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CHLORINATION, WHERE SEPARATE FROM TREATMENT
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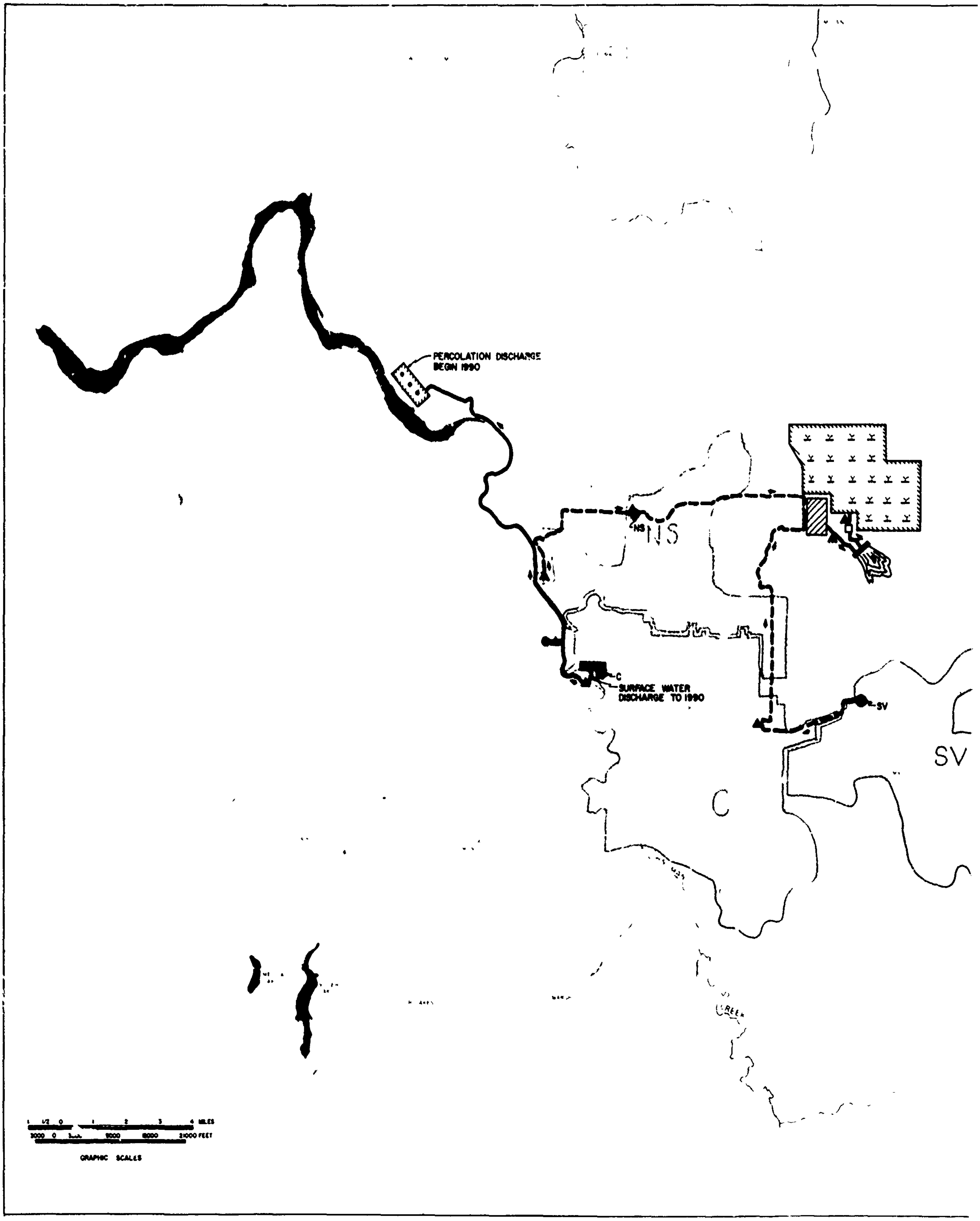

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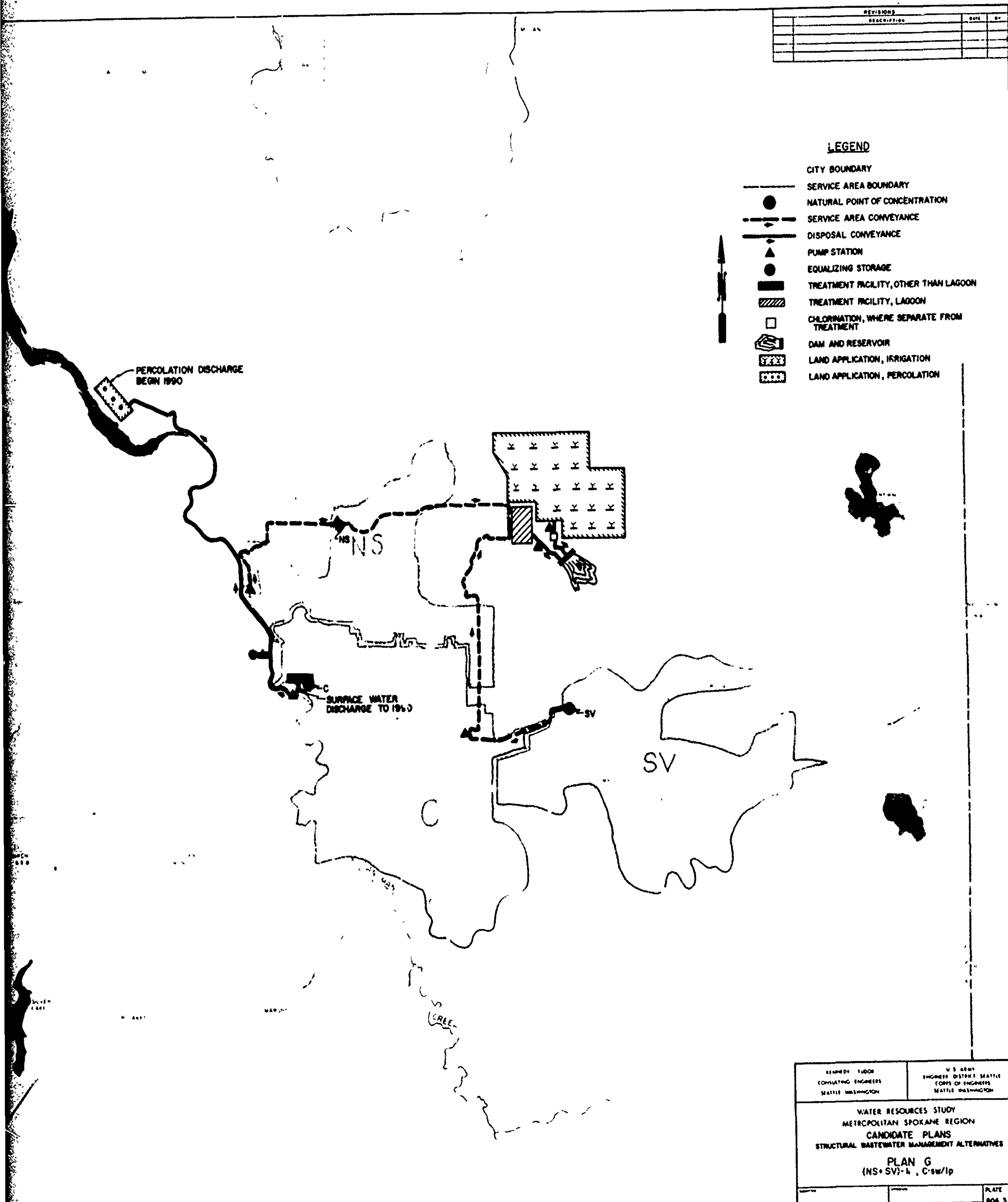
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CHLORINATION, WHERE SEPARATE FROM TREATMENT
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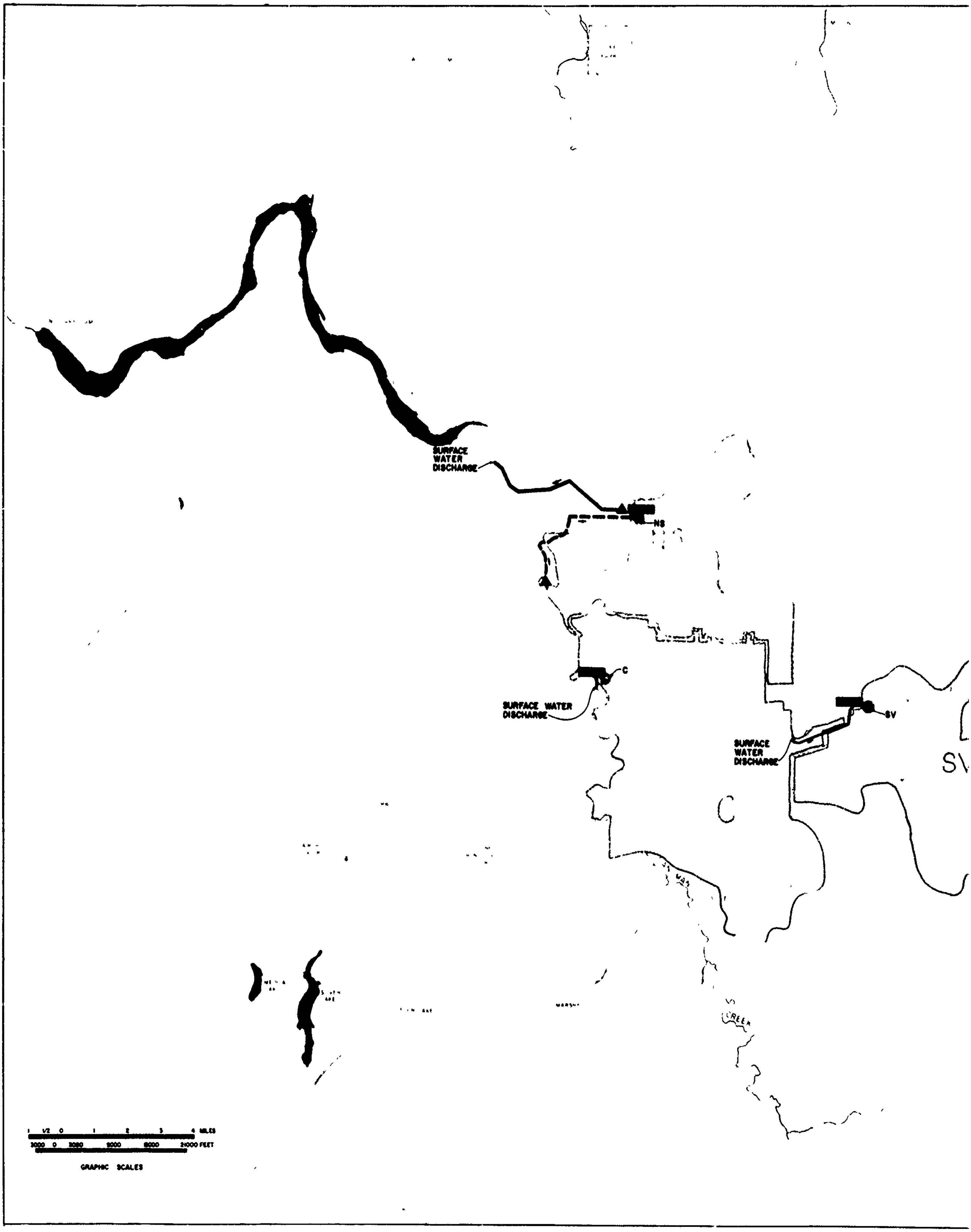
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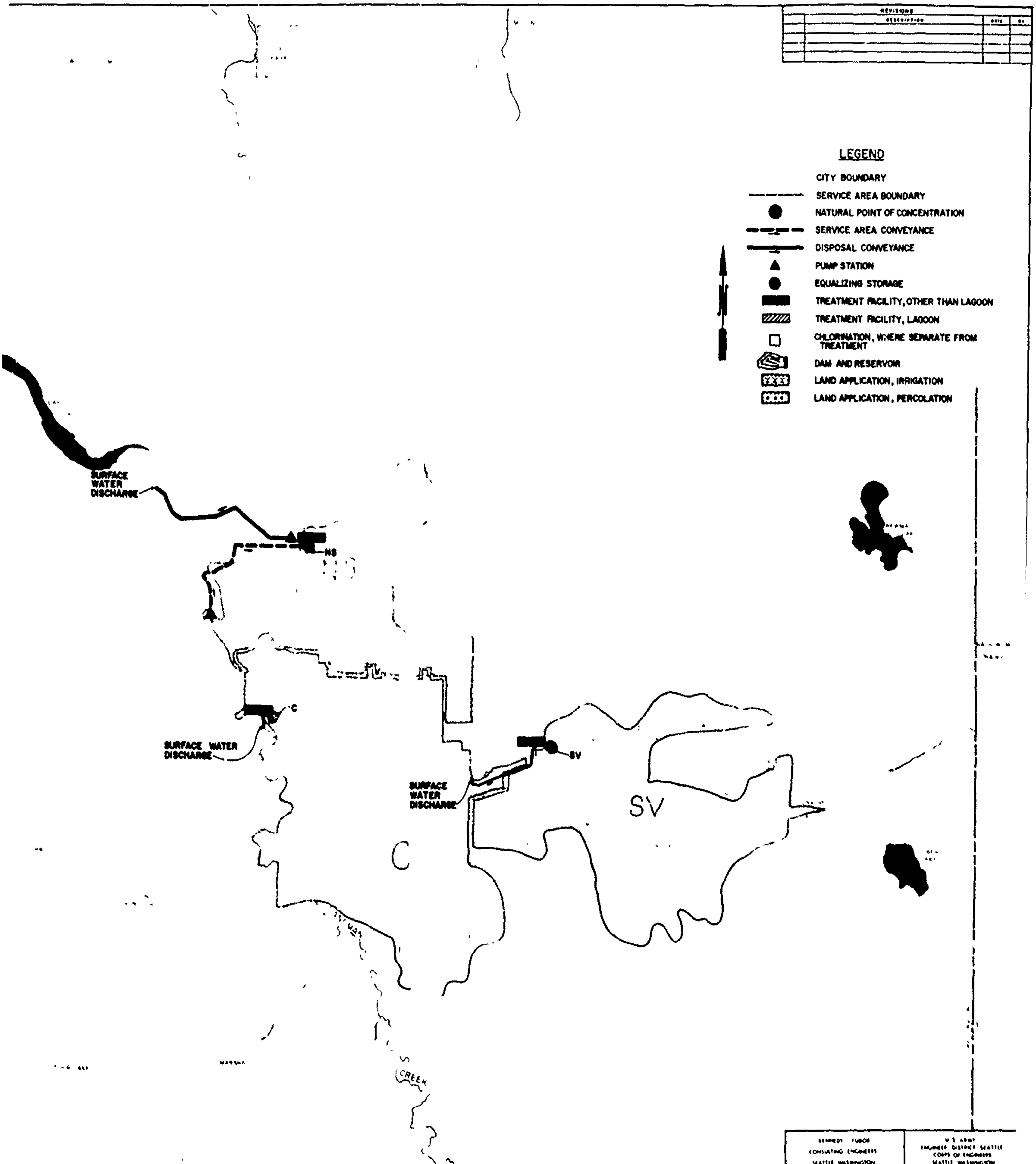

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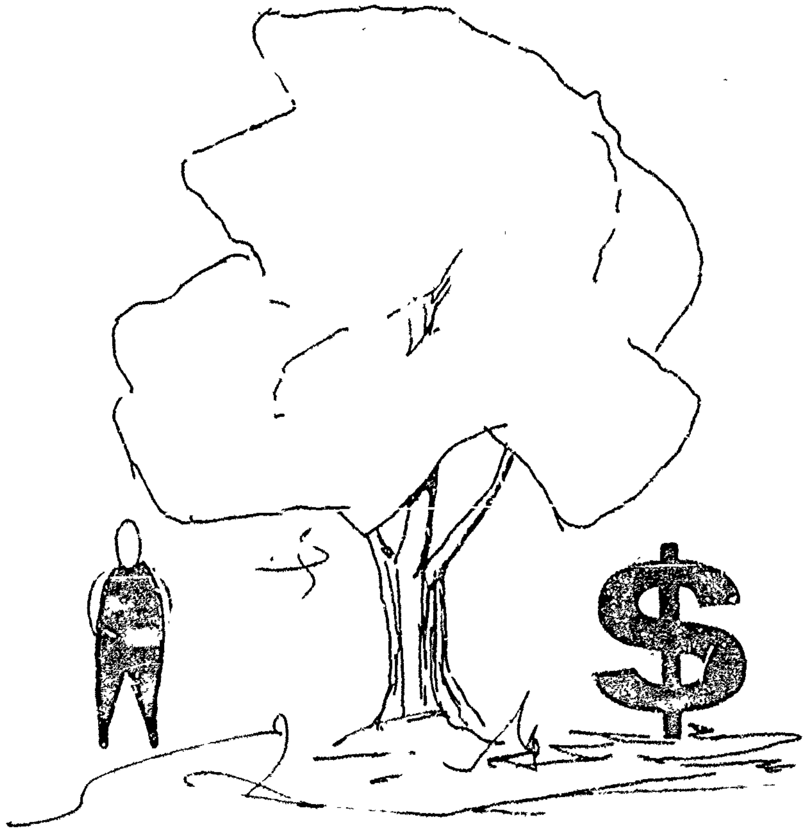

SECTION 701.2

ECONOMIC, SOCIAL AND ENVIRONMENTAL EVALUATION OF CANDIDATE PLANS

WATER RESOURCES STUDY

METROPOLITAN SPOKANE REGION

SECTION 701.2

ECONOMIC, SOCIAL AND
ENVIRONMENTAL EVALUATION OF
CANDIDATE PLANS

8 August 1975

Department of the Army, Seattle District
Corps of Engineers
Kennedy-Tudor Consulting Engineers

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SECTION 701.2
ECONOMIC, SOCIAL AND
ENVIRONMENTAL EVALUATION OF
CANDIDATE PLANS

Introduction

The objective of this section is to make a comparative evaluation of the impact of candidate plans on economic, social and environmental concerns. The candidate plans to be evaluated are the result of initial formulation and initial cost effectiveness screening processes as shown in Section 701.1

The checklist of concerns to be addressed in the evaluation process is as developed in Section 401.3. The evaluations made at this level of screening are comparative rather than absolute since the primary objective is to reduce the field of candidate plans.

Evaluation considerations are discussed first in general terms as background for a specific narrative evaluation of each candidate plan. The narrative evaluations for each plan are made in a standardized question and answer format. The dialogue is necessarily repetitive since many plans have common impacts, but it is desirable to make each narrative self-contained so that the survivors of this elimination will be understandable by themselves.

The narrative evaluations are summarized in a matrix for comparison. An analysis of the matrix comparison follows and concludes with a recommended selection for final consideration and refinement.

Evaluation of Sludge Disposal Impacts Not Included

All initial alternative formulation plans except the "no

action" plans are based on a single common system of sludge disposal. The formulation and evaluation of alternative sludge disposal plans is to take place in a step subsequent to initial screening of the basic wastewater management plan. It is recognized that all sludge disposal alternatives are not independent of all basic wastewater management plans and that there are significant areas of interaction.

When alternative sludge plans are applied to a reduced number of alternative wastewater management plans, these interactions are to be considered, including iterative analysis where necessary. Therefore, at this point, evaluations do not include the impact of the common sludge disposal system, which is anaerobic digestion followed by vacuum filtration and cake disposal to sanitary landfill. For example, evaluations herein of energy impact do not include thermal energy requirements for digestion tank heating either by sludge gas or an outside energy source.

Evaluation of Internal Collection Systems

All alternatives except "no action" plans include collection of sanitary sewage to a point of concentration for each of the three major service areas. Since these internal collection systems are common to all action plans their impacts are not evaluated under each action plan just as their costs are not included for cost effectiveness analysis. For example the evaluations herein of all plans except the "no action" plans do not include the positive impact on groundwater quality due to the elimination of on-site disposal or the negative

impact of massive disruption due to construction of sewer systems in already developed areas.

The impacts of internal collection systems are evaluated in connection with the total and partial no action plans.

Considerations for Land Irrigation

Land Ownership. Land application alternatives utilizing irrigation require extensive land areas. The social and economic effects of putting new land under irrigation or augmenting the existing irrigation water supply with reclaimed wastewater depend upon the assumption of land ownership.

For the purpose of cost effectiveness analysis, the land ownership assumption should not effect the results as measured in total project cost, but it does effect the sectors of the economy involved. The cost effectiveness analysis is based on ownership of all land used for land application being testing in the wastewater management agency. Thus, the project is charged with the cost of buying the land and holding it throughout the planning period. Since land is salvaged at its original cost, in conformance with cost effectiveness guidelines, the cost of land ownership is equal to the interest on the investment, which theoretically should be equal to a fair rent, not including taxes. The wastewater management agency is likewise charged with the capital and operation costs of adding irrigation facilities to the land but credited with the net return from the sale of the crop. Since the net return on the crop is estimated as such it is not necessary to assume

who actually plants, cultivates, harvests and markets the crop. Presumably this could be either the water management agency itself or a contractor.

Alternatives to having the wastewater management agency own the land and operate it include the following:

(1) Owning the land but leasing back the land to operators, including the water supply, for a fixed fee with the leasor retaining the returns on the crop.

(2) Selling water to private landowners in a manner to an irrigation district.

(3) Entering into agreements with private landowners to take the water and operate their farms in a way to best utilize and dispose of the reclaimed wastewater.

These alternatives including the one assumed for cost effectiveness can be seen to have potentially widely varying social and economic impacts. The assumption of land ownership by the wastewater management agency will result in the large scale displacement of people and the removal of extensive acreage from the tax rolls. A water use agreement with private landowners would not necessarily displace people, but a significant number might not choose to continue farming at that location under the restrictions of the agreement. The effect on tax rolls can vary from complete loss of the area to an increase in assessed valuation.

It is premature at this stage of wastewater management planning to attempt to solve the implementation problems inherent in land ownership and operation for land irrigation. The very fact that it is an implementation problem is a significant impact to be considered in

comparative evaluation with other alternatives. For the purpose of this level of evaluation, it is judged that preempting of any large scale area for irrigation with reclaimed wastewater constitutes a negative impact with respect to dislocation of people and disruption of accustomed patterns. Specific sites differ in the degree of potential dislocation due to the differing densities of present occupation. Relatively large ownerships, averaging 160 acres or more predominate in all three areas.

Due to the lower existing intensity of agriculture in the Airways Heights area, disruptive potential is evaluated lowest of the three sites. Williams Valley is ranked second lowest due to the fact that the use under irrigated conditions is practically the same as at present. The Peone Prairie is ranked as having the highest disruptive potential due to the change in crops.

The eastern part of the Spokane Valley is not used as an irrigation site in any of the developed plan alternatives for reasons discussed elsewhere. It should be noted, however, that another reason for not using the Spokane Valley as a disposal site is its potential for a very high degree of disruption due to land ownership in relatively small holdings of diverse use.

Cost effectiveness analysis does not include a cost item for relocation, only the land value is charged. Experience in one site where a large scale land acquisition was made for wastewater irrigation (Muskegon County, Michigan) indicated that relocation costs added 20 percent to land costs.

Productivity. The lands available for irrigation in the study area vary widely in their present productivity and their future potential under irrigation. Thus the potential for overall economic gain to the region is highly variable and must be considered on an individual site basis. The following discussions for the three sites are the basis for the brief statements of impact under the respective plans which utilize these sites.

Williams Valley: This area is estimated to be eighty percent cultivated at present, predominantly in alfalfa and permanent pasture and some grain. Soil is fair and sandy. Most is dry farmed but there are some areas under irrigation from both groundwater and surface water sources. The natural supply of moisture from rainfall, 20 to 23 inches, and moisture holding capacity of the soil at 5 to 8 inches, naturally satisfies the soil moisture needs moderately well, considering the length of the growing season. The addition of an irrigation supply is estimated to increase productivity approximately 25 percent over current levels, with the growing season becoming the primary limiting factor in crop yield.

The expected incremental productivity is estimated to be $25 per acre per year, in current dollars (neglecting the cost of irrigation).

Peone Prairie: This area is estimated to be more than 90 percent cultivated at present. Soil is good and the growing season is slightly longer than the Williams Valley. Fair yields are now obtained without irrigation in wheat, peas and lentils. Rainfall ranges from

20 to 22 inches per year and soil moisture capacity is good due to fine textured soil. Irrigation is estimated to increase production in the range of 20 to 30 percent, again with the growing season as a limiting factor. The soil in Peone Prairie is good enough to go to different higher value crops under irrigation if markets could be developed. For maximum water application rate, alfalfa cropping is assumed for cost effectiveness analysis. The incremental net dollar yield, under irrigation but not including the cost of irrigation, is estimated to be 20 percent more than income from current crops. The increment measured in current dollars is estimated at $20 per acre per year (neglecting the cost of irrigation).

Airways Heights: This area has generally poor soil with low moisture holding capacity and low rainfall. As a consequence, the present general level of agricultural production is very low. There is a thin layer of fine textured soil overlying coarse materials. The limited depth of the fine materials limits moisture holding capacity to about 4 inches and rainfall is in the range 17 inches. Existing agriculture is limited to low yield dry farming. Irrigation of this area would add significantly to productivity. Due to the low moisture holding capability of the soil, water application rates are expected to be smaller and frequency of application higher. The expected incremental productivity is estimated to be $55 per acre per year in current dollars (neglecting the cost of irrigation).

Groundwater Quality Impacts. The intent of irrigation application of wastewater is to take advantage of the advanced degree

of treatment afforded by the surface soil layers. Although much of the applied water is returned to the atmosphere by evapotranspiration, some percolation must take place in order to protect the soil from salt buildup which would eventually render the land sterile. Thus percolation to groundwater must take place unless underdrains are provided to intercept the percolate and return it to surface waters. The percolate which reaches groundwater will include all soluble substances not incorporated by plants or removed by reactions with the soil itself. Some dissolved substances are utilized by plants in significant amounts, but excessive rates of application can leach nutrients beyond the root zone where they can be utilized, with the result that the unutilized materials appear in the percolate. Thus, land irrigation will inevitably impact groundwater quality to some degree; the critical concern being whether the impact is acceptable.

The quality of the percolate and hence its degree of acceptability are functions of the control exercised over the irrigation process and the kind and depth of materials overlying the water table. These concerns are summarized in the following materials abstracted from Pound and Crites, Vol. II (1973) pg. 59:

> Nutrients that are not used by plants or fixed in the soil can leach down to groundwater and cause contamination. The major element of concern is nitrogen. Nitrogen in the nitrate form is used by plants for the growth process. Nitrates that are not utilized are highly mobile and will leach down to the groundwater. If concentrations are high enough, the groundwater can become contaminated and unsuitable for domestic consumption. The U.S. Public Health Service Drinking Water Standards recommend a concentration limit of 10 mg/L for nitrate nitrogen.

Phosphorus in the wastewater may also leach to the groundwater if it is not used by the crop or fixed by the soil; however, this occurrence is rare in irrigation practice. Soils with appreciable organic or clay contents adsorb practically all of the phosphorus applied by wastewater irrigation.

Organics can appear in groundwater when there is a high application rate of wastewater or when there is an open soil, such as sand or gravel, with a high percolation rate.

Organics are usually broken down by microorganisms and used by plants--with open soils, the water carries the organics through the soil too fast for the bacterial action to take place.

Toxic compounds can be changed by the chemical reaction of cation exchange and can be rendered nontoxic by bacteria under cometabolism. Chemical precipitates that are formed can be leached out of the soil if a heavy loading occurs or if a significant decrease in pH occurs.

Enteric organisms usually do not reach the groundwater because they are removed or die out before the groundwater level is reached. Where crops are grown, the groundwater is usually kept low enough so that the organisms are eliminated from the percolating water before it reaches the groundwater.

The TDS concentration in the groundwater is affected by the leaching of minerals from the soil. The U.S. Public Health Service has recommended maximum level for TDS of 500 mg/L in public water supplies....

The expected quality of percolate from well operated irrigation systems with monitoring surveillance is as follows:

Parameter	Expected Concentration mg/l
BOD	0.3
Total N	3.0
Total P	1.0
Organics	Trace
Heavy Metals	None
Coliform Bacteria	None
Virus	Unknown
TDS	Twice the Applied

This says in effect that within the present bounds of knowledge of the soil treatment mechanisms, the impact upon groundwater of well managed wastewater irrigation on a properly selected site is acceptable. Whatever reservations are held upon the acceptability of impact in general have their significance when applied to specific sites.

Williams Valley is underlain with the upstream end of the aquifer which fills the Little Spokane Valley. From the standpoint of soil material and depth to water table, the situation is favorable to protection of groundwater quality. From the standpoint of groundwater use, any impacts would effect significant numbers of water uses downstream.

Peone Prairie is underlain with similar aquifer materials of lacustrine origin as the Williams Valley but the surface materials are much finer being mostly reworked loess. From soil material and depth standpoint, a higher level of protection is provided than the Williams Valley. The use from the aquifer is likewise at a lower level.

Airways Heights is underlain by the Columbia Plateau basalt formations at relatively shallow depth and the surface materials are very coarse sands. The basalt is vertically jointed and would admit percolate to the top layer. Horizontal beds of low permeability material would probably prevent recharge of lower basalt strata. The shallow coarse soil and vertical jointed basalt provide low levels of protection of the highest horizon of the basalt aquifer. There is extensive

use from the basalt aquifer but little is known of the horizontal movement or the extent to which any impact would be felt.

Environmental Impacts. The assignment of extensive areas to a uniform type of cropping under irrigation with reclaimed wastewater will change the character of that area significantly from a varied cropping pattern under dry farming or scattered irrigation. The change will effect the kind of wildlife inhabiting the area. A notable habitat for a variety of forms is the uncultivated margins of field and fence rows which would largely be eliminated. Refer to Section 315.52. Fields of irrigated alfalfa or pasture will be attractive to different forms than other variegated crops. It is difficult to assign positive or negative values to the change. Primarily for reasons of reduction in variety, the change is evaluated as a negative impact on wildlife habitat.

From an aesthetic standpoint, a similar impact results in the change from the varied rural scene to a uniform landscape. Furthermore, the possible restrictions on public access and the designation of a buffer zone, would highly restrict use of the area by the general public, as for example bicycling on back roads. The impact on aesthetics is evaluated as negative.

Farmlands to a limited extent provide hunting areas which fulfill a part of the recreation need. The changes in habitat and limitation of access again combine to create an impact that is evaluated as negative.

Public Health Concerns. There are four primary areas of

public health concern deriving from use of treated sewage for irrigation. These are:

(1) Potential hazard from pathogens in spray generated aerosols.

(2) Pathogen survival on harvested crops.

(3) Pathogens and chemicals introduced into surface or groundwaters.

(4) Exposure of workmen on the irrigated lands.

These hazards are all recognized in the proposed alternative plans and precautions are taken. There will remain, however, the uncertainties derived from limited knowledge in some areas and the possibility of accidents. The public health impact of irrigation alternatives is evaluated as more negative relative to surface water and infiltration-percolation.

Impact of Storage Facilities. In addition to the impact of the irrigated lands themselves, consideration must be given to the impact of the required storage facilities. The size of required storage can be met economically only by open reservoirs constructed in natural canyons. Significant land areas are involved with consequent impacts in many categories including dislocation of people, loss of productive land, destruction of vegetation, change in wildlife habitat, recreation potential, aesthetics, groundwater and surface water quality.

The nature and operation of the storage reservoirs provide little potential for positive impacts for wildlife habitat, recreation or aesthetics that are normally associated with an artificial lake.

The reservoirs must be either built to excessively large size with larger volumes of dead storage or they must be operated through a wide range of levels each year. The wide variation in levels makes the lakes aesthetically unattractive and of marginal value for wildlife habitat. The secondary effluent, even with disinfection, would not be acceptable for direct recreational uses. Heavy algae growths can be expected due to the high nutrient level in the treated wastewater.

There are also potentials for negative impacts on both surface and groundwaters. The potential threat to surface waters is small and would derive from the remote possibility of an overflow. The reservoirs are selected with extra volume to capture local runoff without overflow, but there is always the chance for unusual combinations of circumstances to cause overflow. Adequate spillways are provided in this event to avoid structural damage. A greater potential threat exists to groundwater. To evaluate this potential a preliminary geological investigation has been made for the candidate reservoir sites and is included herein for reference as Appendix I. The specific groundwater threat for each site is summarized below.

Prufer Reservoir Site: The reservoir bottom is moderately permeable and the underlying aquifer joins the Mud Creek and Dragoon Creek groundwater areas. The enclosing rock basin forms an impervious barrier except at the dam site. Seepage under the dam from the reservoir bottom is probably controllable by construction of an adequate cutoff wall and possible blanketing. The potential adverse groundwater impact is evaluated as moderate.

Old Trails Site: Both the unconsolidated overburden and the basalt rock at this site are susceptible to seepage. Uncontrolled leakage could enter the basalt groundwaters and the river terrace materials at Camp Seven Mile. The river terrace materials eventually drain into the Spokane River. The groundwater area affected is relatively small. The potential adverse groundwater impact is evaluated as low to moderate.

Bruce Canyon Site: If a dam foundation can be constructed on Latah Formation leakage should be minimal at this site. If the unconsolidated overburden is too deep to be economically penetrated by the dam, the site may be impractical. The leakage paths to significant groundwater bodies in the Peone Prairie appear to be highly irregular. Assuming that the practical construction on Latah Formation is possible the adverse groundwater threat is evaluated as low.

Specific evaluation of the three storage sites relative to social and environmental factors is as follows:

Prufer Reservoir Site: The site is presently occupied by active farming. Loss of productivity and dislocation of families are the more important negative impacts. The site is almost entirely cleared of native growth and there are no known unusual wildlife habitats.

Old Trails Site: Most of the site is occupied by dry farmed agriculture and there are no significant stands of native growth or wildlife habitats except those associated with the croplands. The most significant negative impacts are those of productivity loss and dis-

location and these are of relatively small magnitude for this site.

Bruce Canyon Site: The site is occupied by relatively small "horse ranch" type development and significant areas of woodlot. The negative impacts are evaluated as high for dislocation of people, native vegetation, wildlife habitat and aesthetics.

Considerations for Land Percolation

Site Concerns. The impact caused by the change in use of a site from its present use to that of an infiltration pond is less than for irrigation due to the great reduction in area required. The impact on the area effected, however, is much greater. No useful crop is usually produced on infiltration beds although some utilize vegetative cover. The appearance suffers a major alteration by leveling and building of dikes, control structures and access roads. The usefulness of the site as a wildlife habitat is usually limited to wildfowl. The site impact at specific sites is evaluated as follows:

Downriver Site (terrace on north shore of Long Lake): The site is a gently sloping one largely covered by the open pine forest typical of the area. The area is not developed at present but appears to have attractive potential for residential or recreational development. Use of the site for infiltration-percolation would have negative impacts on wildlife habitat, natural vegetation and aesthetics.

Confluence Site: The site is partly open and partly tree covered gently sloping undeveloped land with good recreation potential as an addition to Riverside State Park or as residential area. Use of

the site for infiltration-percolation would have negative impacts on wildlife habitat, natural vegetation, aesthetics and recreation potential.

Mead Site: The site is mostly open between industrial and agricultural areas. The major impact caused by use of this site would be disruption of circulation and loss of industrial land potential.

Groundwater Quality Concerns. The strongest impacts of infiltration-percolation are on groundwater quality. In some areas where native groundwater is scarce or quality is poor there is potential for positive impacts by renovated wastewater recharge. In the specific cases in this study, the natural groundwater quality is exceptionally good and the groundwater is abundant. Hence, the addition of high quality renovated water must be regarded as a degredation of the natural condition to some extent. The proposed alternatives contemplate secondary treated wastewaters applied at conservative rates to sites with great depth above the saturated zone. Under these conditions the quality of the renovated water which reaches the water table is expected to be good with respect to BOD, suspended solids and coliforms. Knowledge of removals for heavy metals, trace elements, refractory organics and viruses is less complete but are likewise expected to be good. The parameters of primary concern are nitrogen and total dissolved solids which are known to pass freely through the soil. There is also the possibility of some concern for long term phosphorus removal where the percolate eventually discharges to a surface water impoundment. Total dissolved solids are a concern only where the

natural levels are high or repeated recycling is contemplated which would cause a buildup. Neither of these conditions apply to specific conditions for study alternatives. Specific concerns for specific sites are as follows:

Downriver Site: The renovated wastewater is expected to discharge to Long Lake with little opportunity for withdrawal by groundwater users. The alternative plan is predicated on the adopted criteria that general access to the groundwater downstream from the confluence of the Little Spokane River can be controlled so that pretreatment for nitrogen removal is not required. This likewise eliminates any residual concern for those parameters whose removal is not completely certain. A long term concern for exhaustion of the phosphorus holding capacity of the soil must be kept in mind pending actual experience with operation of the site. The overall evaluation of the Downriver Site is for a small negative impact on groundwater quality.

Confluence Site: Alternative plans for this site include nitrogen reduction in pretreatment requirements. Thus, although control of downstream access to the aquifer is not assumed, the renovated water should not pose a threat on the basis of nitrogen content. Also, the uncontrolled downstream access to the aquifer is small. Here also, the renovated water may also reach Long Lake after relatively small horizontal travel. Therefore, there could be again a long term concern for exhaustion of phosphorus holding capacity of the soil. The overall evaluation of the potential impact on groundwater is a very small negative one.

Mead Site: Alternative plans include nitrogen removal in pretreatment. The uncontrolled access to the aquifer downstream from the site is a significantly large area so that there is an exposure to the unknown risks involved for parameters whose performance is uncertain. The path to surface waters is long so there should be little concern for exhaustion of phosphorus holding capacity. The overall evaluation for this site is a low negative impact.

Considerations for Surface Water Disposal

1983 Criteria. All surface water disposal alternatives to meet 1983 Criteria include a high level of secondary treatment plus year around or seasonal phosphorus removal with disinfection by chlorination. For alternatives that include the City, seasonal nitrification is also included to eliminate any threat of ammonia toxicity.

In the absence of a malfunction of the proposed treatment facilities all surface water discharges under candidate plans should make the receiving waters capable of meeting Class A conditions as defined by the Department of Ecology. Class A waters are specified to be suitable for all classes of water supply including domestic, fish habitat, wildlife habitat and unrestricted recreational use. They are further specified to have unimpaired aesthetic qualities. Therefore the evaluation of impacts on surface water of the various plans must concern themselves with the relative opportunity for degredation due to malfunction or the improvement above and beyond Class A quality through either unusual treatment levels or complete diversion of

treated wastewater from surface disposal.

There are three surface water discharge locations. The specific impacts for these locations with 1983 discharge criteria are evaluated below with respect to use of the receiving waters for:

(1) Fish habitat.

(2) As an element of bird and wildlife habitat.

(3) Utilization as domestic, agricultural and industrial water supply.

(4) Recreation Use.

(5) As an aesthetic element.

At City STP:

(1) At present with primary treatment fish habitat is adversely affected by low DO in the stretch from the STP to Long Lake and in Long Lake. Under natural conditions (that is, with point source pollution eliminated but with the man-made impoundments in place), the DO in the river from STP to Long Lake and in the upper layers of Long Lake would be above 8.0 mg/l at summer low flow conditions; the bottom layer of Long Lake would be aerobic but at very low (less than 2 mg/l) DO levels. Under natural conditions, temperature would be the governing factor in fish habitat except for the bottom layer of Long Lake. Surface water discharges are evaluated against these calculated natural conditions. At year 2000 with all service areas concentrated to the City STP site, the estimated DO below the STP at summer low flow is above 8 mg/l and over 5 mg/l in the surface layers of Long Lake. It is anticipated that the surface water discharge under 1983 criteria will provide fish habitat approaching natural conditions in the Spokane River and in Long Lake, with the degredation being most noticeable in the middle layers of Long Lake.

(2) The level of treatment provided by 1983 criteria would make no significant difference in the quality of the River from natural conditions as an element in bird and

wildlife habitat.

(3) There are at present no domestic, agricultural or industrial water supplies drawn from the Spokane River below the City STP or from Long Lake. The estimated water quality at low flow below the STP for year 2000 with the entire service area flows to this site are compared with estimated natural conditions as follows:

Parameter	Units	Forecast Values Yr. 2000	Natural
Temperature	°C	13.3	12.6
Dissolved Oxygen	mg/l	9.0	9.8
BOD	mg/l	2.5	0.5
Total Phosphorus	mg/l	0.153	0.017
Total Nitrogen	mg/l	2.85	1.33
Ammonia - N	mg/l	1.275	.023
Total Coliform	No./100 ml	308	Unknown

The above described quality is satisfactory for agricultural supply and all but the most exacting special industrial requirements without further treatment. Except for the coliform count listed above, the parameters of concern for use as a domestic supply are those that have only recently been cited as potential hazards such as exotic organics, chlorine compounds and heavy metals. Considering pathogens only, the river water could be treated to domestic supply levels by the common water treatment processes of chemical coagulation, sand or multi-media filtration and chlorine disinfection. Concerns for organics and chlorine compounds could require further treatment by carbon adsorption and/or ozone oxidation.

The negative impacts to water supply uses are confined almost entirely to the domestic use category and would be significant from a cost standpoint if use for this purpose were contemplated.

(4) The forecast river quality meets current standards for all recreation uses. Despite meeting the letter of the law, there is no doubt that a major treated sanitary discharge with a relatively low rate of dilution constitutes a threat through potential malfunction and through present lack of knowledge of effects from many minor constituents. The very fact that the treated sanitary discharge is there represents a negative impact

on public acceptance for unrestricted recreational use. Recreation impact has high importance since Riverside State Park fronts the river from the City STP to the confluence.

(5) The visual impact of surface water discharge under 1983 criteria is expected to be negligible in the Spokane River itself. Natural (zero point source discharge) conditions are not expected to completely eliminate algae in Long Lake. Surface water discharge with 85 percent or more phosphorus removal is expected to approach natural conditions and represent a large improvement over present conditions. The visual difference between estimated natural conditions and projected conditions with 85 percent phosphorus removal is difficult to evaluate but is expected to be minor.

At Confluence: Alternatives which use this disposal location include the North Spokane and Spokane Valley service areas but do not include the City. For those alternatives which combine surface water discharge at this point with City surface water discharge at the City STP site, the impact on Long Lake is substantially as described above for all three service areas to the City STP. For those alternatives which combine surface water discharge at this point by North Spokane and/or Spokane Valley with City land disposal, the impact on Long Lake is in proportion to the lower volumes of effluent.

The primary difficulty with discharge at this point is that of achieving adequate mixing since a slack water condition exists at most times due to the back-up of Long Lake. Even with special care in the design of diffusor facilities, there is the possibility of depressed DO locally due to lack of mixing.

Evaluations of impacts are as follows:

(1) Fish habitat in the immediate vicinity of the outfall

on public acceptance for unrestricted recreational use. Recreation impact has high importance since Riverside State Park fronts the river from the City STP to the confluence.

(5) The visual impact of surface water discharge under 1983 criteria is expected to be negligible in the Spokane River itself. Natural (zero point source discharge) conditions are not expected to completely eliminate algae in Long Lake. Surface water discharge with 85 percent or more phosphorus removal is expected to approach natural conditions and represent a large improvement over present conditions. The visual difference between estimated natural conditions and projected conditions with 85 percent phosphorus removal is difficult to evaluate but is expected to be minor.

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The primary difficulty with discharge at this point is that of achieving adequate mixing since a slack water condition exists at most times due to the back-up of Long Lake. Even with special care in the design of diffusor facilities, there is the possibility of depressed DO locally due to lack of mixing.

Evaluations of impacts are as follows:

(1) Fish habitat in the immediate vicinity of the outfall

could experience significant negative impact. Negative impacts on Long Lake for North Spokane and Spokane Valley separately from City discharges are evaluated as low, and incrementally to City discharges, as moderate.

(2) Negative impacts on bird and wildlife habitat and aesthetic elements are evaluated as small.

(3) Negative impact on recreation use is evaluated as higher than at City STP since this location is closer to potential points of use and because of the lower mixing potential.

(4) Negative impacts on water supply uses are as evaluated for the City STP site.

At East City Limit: This disposal site is utilized in alternatives to serve the Spokane Valley alone. The point of discharge is extended by pipeline to be downstream from the main City wells to avoid impact on City supply from river to groundwater exchange. This discharge point would expose a reach of river to the impact of treated sanitary wastewater discharge not previously exposed, namely from the east City boundary through the City to the City STP site. This area is at present strongly impacted by combined sewer overflows from the City but these are to be corrected.

(1) The negative impact on fish habitat is evaluated as low despite the increased length of river exposure since the combination of level of treatment and dilution should not cause depressed dissolved oxygen or toxic conditions. The negative impact is primarily that inherent in the risk of a malfunction in treatment.

(2) There should be no significant impact on bird and wildlife habitat.

(3) The recreation uses and opportunities of the river are lower in the reach above the City STP than below. The level of treatment and dilution combined with low recreation exposure minimize negative impacts.

limitations of present knowledge on other possible harmful constituents. Even for this level of treatment, surface water discharge must conservatively be regarded as a negative impact with respect to potential use as domestic water supply.

For this level of treatment, there is no significant distinction between impacts for the three disposal points used in various alternative plans.

General Area Wide Impacts

Scope. There are a number of concerns of an economic, social and environmental character that are impacted in some degree by all alternative plans. The impacts on these concerns do not lend themselves to quantification but, even without quantification, a ranking among the alternatives is possible. Most concerns of this type are area-wide in nature and not dependent upon the specific technology of the alternative plan. These concerns and relative impacts are discussed below as background for the brief summary statement included in the correspondingly numbered narrative evaluation for each specific alternative plan.

(2) Direct Economic Concerns

a. What relative impact will the capital funding of a plan alternative have on the total supply and availability of capital funds to meet other community needs?

All alternative plans involve capital expenditures which will compete with other community needs, particularly in the fields of transportation, education, recreation and other public works. Under other public works are included such projects as internal sewerage construction, expansion, or

improvement programs in support of the overall plan covered by the alternative plan. The level of grant funding at the time of implementation is unknown but could greatly effect the absolute and relative requirements for capital. At the point in this study where an implementation plan is being developed it will be necessary to evaluate the capital needs for the alternative relative to capital needs for other services. At this point, a comparative evaluation is made by ranking the candidate plans in order of the present worth of the capital component of cost.

b. What will be the relative impact of operation and maintenance costs of a plan alternative on utility rates and/or tax rates?

All alternative plans will involve significant operation and maintenance costs which will have to be met by a utility service charge or taxes or a combination of both. These costs are not usually subject to any relief through grants. As with capital costs, the wastewater management plan will be in competition with other public services for the utility service and tax revenue capability of the community. The implementation plan for a recommended alternative will put these requirements in absolute terms and coordinate them with the tax base. At this point, the alternatives are ranked comparatively based on the equal annual cost equivalent of the operation and maintenance costs for the planning period.

c. What impact will any displacements caused by a plan alternative have on employment and community real income?

Significant long term displacement of productivity and employment take place only for plans that involve irrigation. The possible effects on productivity and displacement of people are discussed above under Concerns for Land Irrigation.

d. What impact will any displacements caused by a plan alternative have on tax income of the community?

Significant displacement of land from the tax rolls can take place for irrigation and land percolation alternatives. For irrigation, the implementation plan which determines whether land is to be owned

in fee by the wastewater management agency must be considered before the actual impact can be determined. At this point in the study, land ownership by the wastewater management agency is assumed and lands so acquired are considered to be a negative impact on total potential tax income. The plans are ranked relatively in terms of the market value of the total acreages required.

(3) Indirect Economic Concerns

a. What relative impact will a plan alternative have on the general desirability of this area as a place to operate a business which will be reflected in the rate of economic development of the area?

b. What relative impact will a plan alternative have on the general level of economic activity of the area which will be reflected in property values and tax income of the community?

There are two counteracting forces which determine the net impacts referred to above. The first set of forces are those which make the area a more favorable place to live or operate a business such as general health, attractiveness and leisure opportunities in the areas which are augmented by implementation of the plan. Specific items such as abundant, low cost and safe water supply are positive factors. The second set of forces are those that make the area unattractive to a business already located in the area or one considering location in the area such as high taxes and utility charges.

All alternatives should provide positive impacts with respect to making the area a more attractive place to live and spend one's leisure time. The differences between alternative plans are most significant with respect to negative impacts caused by high costs which make themselves felt as high utility charges and taxes. The candidate plans are ranked comparatively for their potential negative impacts as specifically reflected in total project costs for the planning period considering capital costs, operation and maintenance costs and any diminution of the tax revenue base.

(4) Transient Economic Concerns

a. What will be the relative impact of project construction on local employment during the construction period based on a plan alternative?

Both the kind, skilled or unskilled, and the amount of labor required for construction will vary widely from plan to plan. In general, conveyance facilities and earthwork projects have a higher requirement for unskilled labor than structural treatment facilities which have a high proportion of skilled specialists. Most unskilled labor is hired locally whereas the local labor market frequently cannot fill the needs for a large portion of the skilled workers. Also, conveyance facilities are amenable to being constructed in units that can be sized to be within the capability of local contractors. Thus, the conveyance structures and earthwork elements can be expected to have a larger impact on the local labor and contracting market than would concentrated structural and mechanical facilities. The candidate plans are ranked for their potential impact on the local labor and contracting market in terms of the estimated capital costs for the various kinds of facilities by weighting treatment facilities with a factor of 0.10 and conveyance and earthwork facilities by a factor of 0.25.

b. What impact will the construction of a plan alternative have on local manufacturing and materials supply business?

Similarly to the approach taken for evaluation of the impact on employment, the impacts on local manufacturing and material supply are functions of total volume of construction and kind. Aggregate, concrete pipe and small standard appliances are the types of materials most likely to be supplied locally. Based on these considerations, the candidate plans are evaluated in terms of capital cost for construction with weighting factors of 0.20 applied to conveyance structures and 0.10 applied to treatment works.

c. Will the construction of a plan alternative cause temporary disruptions of circulation and/or business activity that will result in reduced employment or other economic loss?

The primary cause of disruptions of this type are

sewer construction through built-up areas, particularly arterial streets or commercial streets. Less sewer impacts occur for construction on rural roads. The plans are evaluated for negative impacts where this type of construction occurs in support of the basic wastewater management plan. The disruption caused by construction of internal sewage collection systems is not included as an impact on the wastewater management plan just as the capital costs of these sewers are not included in the cost effectiveness evaluations.

(5) Social Concerns for the Community

a. What relative impact will the implementation of a plan alternative have on the health, welfare and safety of the community?

Presumably all alternative plans, other than the "no action" plan, are formulated to have a positive impact on these basic concerns. It is difficult to rank alternatives relative to each other in achieving the goals of maximizing health, welfare and safety. The primary cause for differences are the variation in risk of malfunction which would detract from the planned improvement and the variation in evaluation of risk inherent in each disposal methodology. An example of the latter would be an evaluation of the risk inherent in surface water disposal compared with the risks inherent in irrigation disposal.

Each candidate is scanned for its risk exposure and potential in three basic disposal methods, surface water, irrigation and percolation. Also included are other considerations like the need to pump raw sewage through long pipelines and the risks inherent in possible failure of either the pump station or lines. All concerns are combined on a judgemental basis to arrive at a ranking.

b. Will the implementation of a plan alternative cause disruptions of existing community living patterns such as location, quality and character of residential communities, locations and kinds of employment and general cultural activities?

Disruptive characteristics of various plans are discussed above under concerns for the three

disposal categories. These disruptions are to be enumerated in answer to this question as a basis for relative ranking.

c. What relative impact will the implementation of a plan alternative have on the recreation patterns of the community?

All plans which completely remove surface water discharges will make the Spokane River front, especially in Riverside State Park and Long Lake, available for unlimited water contact recreation use. It is unknown whether this availability will be translated into use by the populace or whether they will continue present patterns for other reasons. Plans with 1985 level treatment for surface water disposal will accomplish substantially the same result. Plans with 1983 level treatment for surface water disposal will vastly improve the availability of the river front for recreational uses but not without some reservations.

The impact of irrigation plans on recreation activities such as hunting and travel through the affected areas are estimated to involve relatively few persons and therefore do not justify inclusion as a major negative impact. Irrigation may improve ground cover habitat for game birds that would be available outside the area.

Other than the above, none of the wastewater management plans significantly effect other aspects of recreation patterns.

Comparative evaluation of impact is directed to the availability of the Spokane River and Long Lake.

d. What impact will the implementation of this plan alternative have on land use and land use planning?

Provision of a workable wastewater management plan for an entire area, when implemented, removes one of the major constraints on land use and development. This means that the control of land use must be through legislative control of land use planning. All candidate plans except the "no action" plan have this impact on the planning process. This common impact is not considered in comparative evaluation under this concern.

The impacts that are considered are those that are dictated by the land requirements or the physical constraints on use posed by the construction of the candidate plan.

In general, surface water disposal plans are considered to have negligible impact on land use and land use planning except for the one area where significant privately held land fronts on the impacted surface waters, such as Long Lake. Improved recreational capability on the shore of the Lake will cause increased pressures for development.

Land disposal plans, in addition to their impact from improved conditions on Long Lake, have extensive impacts for lands required to implement the plan. These impacts require individual citation in the evaluation.

(6) Social Concerns for the Individual

a. Will the implementation of a plan alternative cause dislocations which will effect the place of residence, employment, mobility and general cultural activity of a significant number of individuals?

In general, only irrigation plans call for the permanent displacement of individuals and their resettlement in another area. Surface water disposal plans and infiltration-percolation plans are considered to have negligible impact on this concern. Irrigation plans are ranked relatively in terms of the estimated number of individuals involved.

b. To what extent will the implementation of a plan impact individual life style?

In general, there is judged to be no significant impact by any plan.

(10) Concerns for Air Quality and Noise

c. Will the implementation of a plan have a significant impact on abient noise level?

Treatment processes and pump stations in general are or can be made free of objectionable noise so that one location or method tends o have no more significant impact than another. Engine driven emergency pumping equipment can be a source of noise if no

attempt is made to design for its attenuation. There are now many examples of full time engine driven pumping equipment in residential areas that go essentially unnoticed. Aeration blowers at activated sludge plants have had a similar history and have likewise been greatly improved.

Significant noise problems can arise from truck hauling of sludge. The evaluation of sludge alternatives, however, is not included in this section. This problem of noise associated with truck haul is evaluated in Section 701.3.

For treatment, exclusive of sludge processing, noise is not judged to be of sufficient significance to include in the screening process.

Energy. The ranking of alternatives for their direct use of electrical and thermal energy requirements for treatment and conveyance is possible on a quantitative basis from available data. Since sludge disposal is not included in the basis for comparison at this point, there is negligible use of thermal energy in the treatment process.

Therefore, the primary comparison at this point is based on direct input of electrical energy. At treatment plant sites a significant part of the electrical energy requirement can be met by on-site generation using sludge gas as fuel. For certain sludge disposal options there is no digestion process and hence, no sludge gas. Therefore the utilization of sludge gas is more properly considered with sludge disposal alternatives subsequently.

There are two uncommon energy considerations for candidate plans in this study. These are: (1) the fact that wastewaters discharged into the Spokane River have a significant hydropower potential as they progress downstream through existing Washington Water Power generating facilities and (2) the energy equivalent of the nitrogen fertilizers made available for crop production in the irrigation disposal alternatives. The computation of the potential hydro-power generation of wastewaters discharged to the Spokane River is straighforward with the average fall at each dam known. It must be recognized that at high flow conditions the wastewater increment would be wasted and unavailable for power generation along with a large part of the natural flow since the WWP facilities are not sized for these high flow conditions. The mean monthly natural flows are in excess of installed capacity about 5 to 6 months of the year, therefore, only half of the annual potential can be credited to surface water disposal of wastewater.

Computation of the energy equivalent of nitrogen fertilizer is complicated by the fact that part of the input in the most common

modern process is as natural gas used both for a source of hydrogen and for heat energy. One basis for comparison would be to take as the energy equivalent of nitrogen fertilizer the actual electrical energy used in manufacture plus the electrical energy that could be produced with the natural gas used. On this basis each ton of nitrogen requires an input of approximately 5000 kwh of electrical energy and equivalent thermal energy.

It is of interest to compare the hydro-power potential of all service areas to surface water disposal with the energy required to produce the nitrogen fertilizer carried to irrigation for all service areas. The 20 year hydro-power energy potential for all service areas to surface water disposal is approximately 130 million kwh. The energy required to produce the 20 year nitrogen supply carried in irrigation water is approximately 125 million kwh. That is, the energy produced from hydro power surface water disposal would closely approximate the energy required to synthetically produce the nitrogen carried in the reclaimed wastewater to crop irrigation. This means that these secondary energy credits tend to cancel each other so that the ranking based on direct energy used for treatment and conveyance is substantially unchanged.

Candidate plans are compared for direct energy use and for total net energy requirement considering credits for the above described secondary energy considerations.

Performance. The first objective of this evaluation is to determine the relative overall performance of each candidate plans as

a wastewater renovation system. The second objective is to evaluate the reliability of the system in achieving design performance. Included in reliability evaluation are considerations of process stability and sensitivity and the skill required for operation.

Since all plans provide secondary treatment as a minimum, those systems with extensive renovative processes subsequent to secondary treatment will release the most polished effluent to the environment. Measured in terms of the pollutant concentrations as the treated wastewater leaves the last treatment process, land irrigation produces the most polished effluent followed by land percolation and finally secondary treatment itself.

All of the surface water disposal systems have secondary treatment by the activated sludge process as the basic treatment. Therefore, all surface water disposal plans rank below the land disposal plans in performance for renovative quality. Since there is no storage involved in surface water disposal, the quality of the effluent is dependent upon the continuous operation of the treatment facility at design conditions. Any process failure or upset is immediately reflected in the quality of the effluent. The activated sludge process has been in use for many years and has a high degree of reliability, but it can be upset by shock loads or operational malfunctions. At the City STP site, seasonal nitrification is added to the activated sludge process. This refinement adds to reliability problems.

All of the irrigation disposal plans involve large volumes of storage after the pretreatment process, whether it be activated sludge

or aerated lagoons. A malfunction of the treatment process is not therefore reflected in a corresponding deterioration of the effluent reaching the environment. There is mixing and dilution in storage plus the following land treatment to protect the environment.

The land percolation process likewise provides reliability through storage action incidental to the land application process. The intermittantly loaded percolation ponds provide protection to the environment of pretreatment malfunctions of most kinds, excepting failure to remove nitrogen if this is a requirement of the site. A pretreatment malfunction causes greater operational difficulties to land percolation than to irrigation storage so that a prolonged malfunction may not be contained.

On the basis of the foregoing, land irrigation is ranked highest for both performance and reliability, followed in order by land percolation and surface water disposal. In addition, within these categories, recognition is given to plant size as a favorable influence on both high quality performance and reliability.

Flexibility. Three kinds of flexibility are desirable in a wastewater management plan: flexibility to adjust to unexpected rates of growth or location of growth; flexibility to conform to unexpected changes in discharge standards; and flexibility to adapt to and take advantage of changes in technology. Different system elements are critical to these kinds of flexibility. The relative amount of reliance that the various candidate plans place on these critical elements determines their relative flexibility. It is desirable to identify

these relationships as a basis for ranking the candidate plans.

Flexibility to meet unexpected rates of growth is favored by elements which are or can be built in stages and is disfavored by elements which do not lend themselves to staging. Elements which lend themselves to staging are lagoon treatment, percolation ponds, and irrigation. Elements which do not lend themselves to staging are force mains, sewers and storage reservoirs. Elements which are between these extremes are conventional treatment plants and pump stations. The negative aspects are most critical in evaluation of flexibility. Therefore, evaluation is in terms of the degree of reliance that various plans place on critical negative elements, particularly conveyance structures.

Two special constraints are noted relative to the City. First, the City service area is well saturated so that growth beyond forecast rates is not likely. The more probable unexpected situation would be growth in some locality not now considered, like west of the Spokane River or in Orchard and Peone Prairies. Secondly, the location and existence of the City STP makes access with additional flows extremely difficult and costly.

Flexibility to meet unexpected changes in disposal standards is almost impossible to evaluate since this would depend upon which standards were changed. If surface water disposal standards are raised then a preexisting land disposal system has the advantage. If groundwater protection standards are raised surface water and irrigation disposal have advantages over percolation disposal. If greater

restrictions are placed on irrigation disposal, then surface water and percolation have the advantage. In any case, plans that incorporate either kind of land disposal have pretreatment that with modification can be converted to surface water disposal, giving such plans more inherent flexibility than plans which are committed to surface water disposal only. More sophisticated treatment is usually most advantageously accomplished in larger plants than in a number of small plants. Therefore, plans with fewer plants can more easily meet changed discharge requirements. Evaluation is made on the basis of number of options open by present treatment and the number of treatment facilities.

In order to evaluate flexibility to take advantage of advances in wastewater treatment technology it is necessary to speculate on the general areas in which such advances are likely to be made. Although there is much to be learned about various aspects of land treatment (both irrigation and percolation) with respect to application rates, cover crops, rates and kinds of removals, underdrains and monitoring, it does not seem likely that increased knowledge in these fields will require vastly different technology that would render the basic conveyance, storage and sprinkler application facilities obsolete. Changes in technology are more likely to be in the areas of concentrated site treatment. The unmet needs in these areas are not so much better treatment as lower cost methods or methods which require less space, chemicals and energy. If improved treatment technology were to become available, one prerequisite to its application would be a means of maintaining continuity of treatment while the improved facilities were

being built. The limited space available at the existing City STP site makes such a transition difficult, and increasingly so as the site is more fully utilized. This means that plans in which more of the site capacity is used by other service areas would be at a disadvantage. On the other hand, one plant in which changes were to be made would have advantages over multiple plants. Plans in which all three service areas are concentrated to the City STP are ranked least flexible, plans with North Spokane as the only addition to City STP and lagoon treatment for SV are ranked highest. Plans with two concentrated site plants are ranked second best and those with three separate concentrated site plants are ranked second least flexible.

Narrative Evaluation of Candidate Plans

The general principles outlined above are applied specifically to each of the 8 candidate plans, designated Plans A through H, in a narrative evaluation following the outline of critical concerns developed in Section 401.3. These narrative evaluations are assembled in Appendix II. The evaluations are relative and each evaluation concludes with a statement of relative rank. The ranking is in order of desirability, from 1 for the most desirable to 8 for the least desirable. Where there is judged to be no significant difference in rank, plans are ranked together.

The goal of the evaluation process is to determine the ranking of the candidate Plans A through H for implementation under the existing guidelines of 1983 standards. Some of the candidate plans

also have the capability of meeting interpreted 1985 standards, Plan F throughout the planning period 1980 to 2000; and Plans D and G only from 1990 to 2000. The capability of meeting interpreted 1985 standards is not at issue directly in this step except as the quality of performance is recognized in the evaluation process.

Having made an evaluation on the basis of an obligation to meet 1983 standards, it then becomes desirable to consider the alternatives for meeting a future possible requirement to satisfy interpreted 1985 standards. This second step evaluation is undertaken below under the paragraph Special Subalternative Analysis.

Summary and Analysis of Evaluation

Method. The individual narrative evaluations of the candi-

date plans are summarized in matrix form in Table 1. The ranking of each plan relative to all the others is shown for each critical concern or characteristic.

As described above, the ranking is relative and does not provide a quantitative measure of how much better one plan is than another. There is no intention to indicate by rank in Table 1 how much better one plan is than another.

In order to make an overall evaluation combining the effects of all concerns, it is necessary to quantify both the ranking within each concern and the relative importance of the concerns and characteristics themselves. There is no way to accomplish this in a purely objective way. It must be done on a judgment basis and will therefore inevitably reflect the prejudices, conscious or unconscious, of the authors. To test the effect of bias on the weighting values, different weightings are selected and tested.

As a first step to quantifying an overall evaluation, the characteristics and concerns are separated into two groups, a first level containing those items judged to be of greatest importance and a second group containing those of lesser importance.

Tables 2A through 2D show the evaluation of the Group 1 concerns, the concerns from Table 1 judged to have the most importance in this particular situation. For example, Item 5a concerning Health, Safety and Welfare is not included in Group 1, not because in a general sense this is not <u>THE</u> most important concern, but because the level of protection provided by all plans is so high that the minor

differences provided by each plan should not be given great weight in the selection process.

Tables 3A through 3C show the evaluation of Group 2 concerns and includes all those in Table 1 not placed in Group 1 except items 2a, 2b, 11a and 11c. Items 2a and 2b are not included since they are elements of items 1a and it would be redundant to include them with 1a in a total evaluation. Similarly, items 11a and 11c are elements of the net energy need covered under item 11d and would also be redundant.

In both Tables 2 and 3, the candidate plans are first ranked quantitatively relative to each other for each concern. The highest ranked alternative is assigned a value of one and all others are assigned fractional values in proportion to their estimated performance relative to the highest ranked. Where there is a quantitative basis such as cost or energy use, the fractions are actually computed. Where there is no quantitative basis, judgment is used. Where the spread between alternative performance is judged to be small, the ranking reflects this as well as the opposite condition where the differences in performance are large. The basis for these judgments are covered in the general narrative and in the narrative description for each candidate plan.

The greatest opportunity for bias arises in assigning relative weights to the various concerns in each group and between the two groups. In order to demonstrate the effects of such bias and recognize the possible effect on the evaluation process, a range of rankings is applied. For Group 1, four ranking plans, each totaling 100, are selected:

heavily weighted toward cost, moderately weighted toward cost, moderately weighted toward water quality and heavily weighted toward water quality. For Group 2, three ranking plans are selected: heavily weighted to cost and economic concerns, heavily weighted to environmental and social concerns and a balanced weighting.

The selected weighting for Group 1 and Group 2 concerns are interacted with the relative ranking of the candidate plans for each concern to arrive at weighted rankings. The sums of the weighted rankings for each concern provide a relative ranking for each Group for each weighting plan. These results are summarized on Table 4.

Table 4 divides the candidate plans into two categories, those that meet only 1983 standards throughout the planning period and those that would either meet interpreted 1985 standards throughout, as Plan F, or those that would meet these standards after 1990, as Plans D and G.

To arrive at a total evaluation based on consideration of Group 1 and 2 concerns combined it is necessary to again make a weighting selection for their combination. Two relative weightings are selected for application, one which gives Group 1 three times the weight of Group 2 and one which gives Group 1 nine times the weight of Group 2.

Analysis. The following discussion is based on the results summarized in Table 4.

Considering Group 1 concerns alone, Plan A is highest ranked of plans which meet 1983 standards regardless of how the individual concerns are weighted. Other plans which meet 1983 standards have the same order of ranking, Plans H, C, B and E, regardless of weighting

except for the condition of maximum weighting to water quality where ranking becomes, Plan C, H, B and E. That is, surface water disposal in its various service area combinations occupies the three top ranking positions. In the second ranked position it is only when heavy weighting is given to water quality do the advantages of a single point of treatment and disposal as represented by Plan C overcome its cost disadvantages relative to Plan H with its three separate plants.

The ranking of plans which can meet 1985 standards are more sensitive to the various weighting schemes. The order goes from Plan D, G, F at maximum weighting to cost to Plan G, F, D at maximum weighting to water quality. In all cases, Plans which meet 1985 standards rank below all the Plans which meet 1983 standards except the lowest ranking Plan E. Since the clearly highest ranking 1983 plan, Plan A, can be upgraded to 1985 Plans D and F, this compatability in itself gives Plans D and F an advantage not recognized in the tabular rankings.

The weighted ranking of candidate plans for Group 2 concerns alone is more sensitive to the effects of weighting than for Group 1 concerns. Also since project cost is not in Group 2, there is no consistent advantage to plans which meet 1983 standards over those which meet 1985 standards. The Group 2 weighted ranking goes from Plans F, E, A where economic concerns are given highest weight to Plans A, C, H where environmental and social concerns are given maximum weight. A balanced weighting ranks Plans F, A, C highest. The ranking within Group 2 concerns alone should not be given much significance because of the relatively greater importance of Group 1 concerns. The impor-

tance of Group 2 rankings is in their effect upon the overall ranking when combined with Group 1.

Group 1 and Group 2 concerns are combined on Table 4 in a variety of ways to describe the range of possible outcomes. For the intergroup weighting in which Group 1 is weighted 3 times Group 2, the outcome considering Plans which meet 1983 standards is similar to that for Group 1 alone. Plan A is ranked first for all weighting combinations, followed by Plan H where cost and economics are emphasized and by Plan C where water quality and environment are emphasized. Plans which meet interpreted 1985 standards rank lower than the top three Plans for 1983 standards except at the level of heaviest weighting toward water quality and environment at which point Plans F and G rank second only to Plan A.

For intergroup weighting which assigns Group 1 nine times the weight of Group 2, the impact of Group 2 rankings becomes insignificant and results are substantially as described above for Group 1 alone.

Conclusion. The foregoing indicates that Plan A is the leading candidate for its inherent advantages of:

(1) Cost

(2) Protection of groundwater

(3) Low energy requirement

(4) Compatibility with alternative plans for advancing to 1985 requirements

(5) Flexibility to include or exclude Spokane Valley without jeopardizing the plan advantages

(6) Minimum disruption of the community and land use

When considering interpreted 1985 requirements, Plans D and F are feasible as upgradings of Plan A. Plans D and F have most favored rankings among the group which can meet 1985 standards except under certain weighting conditions when Plan G becomes more favored. Plan G, however, is less flexible with respect to development of a low cost interim plan while 1983 standards are in force and is less flexible regarding the inclusion of Spokane Valley. For these reasons, Plan G is not recommended for further analysis.

It is recommended that Plan A be given primary consideration for implementation to meet 1983 standards with Plan H being a secondary selection. For recommendations regarding upgrading to interpreted 1985 standards further analysis is developed below.

Special Subalternative Analysis

It is demonstrated above that Plan A is the leading candidate to meet 1983 standards or for a step implementation plan which is capable of later upgrading. Two of the three upgrading alternatives, infiltration-percolation and land irrigation, Plans D and F respectively are explored in the process of screening for a basic alternative. It should be recognized that Plan F in the basic selection process is for implementation of land irrigation beginning in 1980. For the purpose of this subalternative study, land irrigation is being considered as a potential upgrade added to Plan A in 1990. This subalternative is designated Plan F-1. The third alternative which has not been explored is upgrading by adding advanced site-intensive treatment processes to

the secondary facilities of Plan A. This plan is identified in Section 701.1 as (C+NS) sw/swt, SV sw/swt and is herein referred to as Plan J. Since Plan J has a cost which is intermediate between Plans D and F-1, a subalternative analysis comparing Plans D, J and F-1 as supplements to Plan A suggests itself.

A narrative evaluation of Plan J is included in Appendix II. A summary ranking of characteristics and concerns limited to these three alternatives all considered as upgrades to Plan A is shown in Table 6. Tables 7 and 8 carry the weighted comparisons through Group 1 concerns for the moderately-weighted-to cost and moderately-weighted-to-water quality evaluations. The refinement of Group 2 evaluation is not carried out based on their negligible impact demonstrated above. The Group 1 evaluations indicate Plans D and J as being distinctly more favorable than F-1 but with no strong advantage of one over the other between Plans D and J.

Keeping in mind that this evaluation is from the viewpoint of alternatives that may or may not have to be exercised and if so not until 1990, other considerations should be recognized. Most significant are that technological advances and relative cost changes could radically shift the ranking. Plan J suffers from the high cost of present known processes for nitrification-denitrification and for carbon adsorption. Increased fertilizer costs could improve the ranking of Plan F-1. Increased need for intensive agriculture could improve the ranking of Plan F-1. On the other hand, increased energy costs or availability could lower the ranking of Plan F-1.

One of the outstanding advantages of a site intensive process as exemplified by Plan J is that it can be adjusted to different levels of disposal criteria by different levels of expenditure and is not inherently an all or nothing commitment like going to infiltration or land irrigation. If the future requirement is something less than what has been interpreted herein as the possible equivalent of the 1985 goal, then a modified and lower cost version of Plan J would increase its relative advantage over the land application systems.

The primary result from this exploration of alternatives to upgrading of Plan A, is to demonstrate the advantage of Plan A as the initial implementation for its flexibility in being compatible with several upgrading alternatives and the advantage of gaining time to resolve the future selection. None of the three alternatives should be excluded from further consideration at this time. Plan D remains a favored choice pending whatever development the future may bring between now and 1990.

Legal Constraints

The large scale use of land application alternatives, both irrigation and infiltration percolation, is so limited to date that the legal consequences of these plans are not readily predictable. A recent article by Walker and Cox (1974) explores the possible legal reactions to wastewater application to land. These concerns include the possibility of suits instituted to object to the siting of land application facilities based on zoning and nuisance, impact on groundwater quality, and impact on surface water rights. It is not within the scope of this study to attempt to evaluate these as yet undefined legal constraints. They are mentioned here as a cautionary note so that appropriate legal advice will be sought and incorporated in the planning for implementation of any recommended land application plan element.

Comparison with the "No-Action" Plan

The "No Action" Plan. The "no action" plan is defined as follows: (1) The City alone would be served by the City STP, upgraded and enlarged in accordance with the current commitment; (2) suburban areas in Moran Prairie and Southwest would continue with individual on-site disposal; (3) North Spokane would continue with a mixture of individual on-site disposal and grouped on-site disposal; and (4) Spokane Valley would continue with individual on-site disposal.

Costs. The candidate plans other than the "no-action" plan are compared by cost effectiveness analysis excluding the cost of any required internal sewage collection systems. In making a comparison between the "no-action" plan and all other plans the cost of the internal collection systems becomes a significant consideration to be measured against the cost of on-site disposal facilities.

For the City service area, the "no action" plan is essentially equal to plan element C-sw. The primary costs for this plan element are the operation and maintenance costs for the City enlarged and upgraded STP, for which the capital costs are sunk costs. Since the City is sewered, the future internal sewerage costs are limited to extensions to new growth where needed, but most population increase will undoubtedly be served from existing sewers. Therefore, the costs for the City element of the "no action" plan are judged to be not significantly different than the C-sw element.

For the North Spokane and Spokane Valley service areas which are presently served by on-site or interim disposal facilities there is a significant additional cost consideration for the "no action" plan in

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For the North Spokane and Spokane Valley service areas which are presently served by on-site or interim disposal facilities there is a significant additional cost consideration for the "no action" plan in

Valley. As a check on these costs, reference is made to two literature sources which present average overall system costs without regard to size, configuration, or specific density. Smith and Eilers (1970) gives \$280 per capita when adjusted to current price levels and Carelli (1971) gives \$385 per capita, also adjusted. It is not unexpected that specific layouts for these areas would develop significantly higher costs than figures derived from national and state averages due to the unique patterns of development, particularly in Spokane Valley. The costs developed from preliminary layouts are utilized below in evaluation of the economic impact of sewerage required by all action plans as compared with the "no action" plans.

The present worth of a sewage collection system* for North Spokane constructed incrementally over the planning period is \$16,400,000. The present worth of on-site facilities to serve the forecast growth from 1980 to year 2000 is \$2,600,000. On site and interim facilities to serve the population prior to 1980 are sunk costs. Thus the net present worth of capital costs to provide internal sewage collection for North Spokane after offsetting the cost of on-site facilities is \$13,800,000. Operation and maintenance costs for both sewers and septic tanks over the 20 year period are not included in the foregoing nor is there any consideration given to replacement of drainfields. Approximately one-half of the total sewerage expense for the planning period would be incurred in 1980. The net present worth per capita is \$309.

The present worth of a sewage collection system for Spokane

*Not including house laterals or internal plumbing modifications.

Valley constructed incrementally over the planning period is $38,000,000. The present worth of on-site facilities to serve the forecast growth from 1980 to year 2000 is $2,300,000. Offsetting the on-site costs, the net present worth for sewering is $35,700,000. In contrast with the North Spokane area, the initial sewerage expense for Spokane Valley in 1980 is approximately 82 percent of the total planning period expense. Likewise, the net present worth of sewerage for Spokane Valley is $482, more than 50 percent higher than North Spokane.

Using the above data and combining it with cost effectiveness estimates for plan elements previously developed in Section 701.1 it is possible to make a cost comparison between "no-action" for North Spokane and Spokane Valley with the lowest cost structural alternatives. The lowest cost structural alternative for North Spokane alone is the surface water disposal element NS-sw which has a present worth cost of 11.3 million dollars for 1983 criteria and seasonal phosphorus removal. The corresponding figure for Spokane Valley (SV-sw) is 16.0 million dollars.

	Present Worth Costs, Dollars	
	North Spokane	Spokane Valley
Structural Alternative for surface water disposal	$11,300,000	$16,000,000
Internal sewer collection system	17,200,000	52,700,000
Subtotal, lowest cost action plan	$28,500,000	$68,700,000
Capital Cost of On-Site Facilities for "No-Action" Plan	$ 2,600,000	$ 2,300,000
Net incremental Cost above the "No Action" Plan	$25,900,000	$66,400,000

Note that the net cost of internal sewage collection is, in both cases, more than the costs of the lowest cost separate disposal alternative. Also note that the system which has developed the farthest under the on-site system has the highest net unit cost for a collection system.

A study made by Cotteral and Norris (1969) considered the economics of septic tanks and sewers including disposal facilities. Their results are summarized in the following table.

COMPARATIVE ANNUAL COSTS OF SEPTIC TANKS AND SEWERAGE

Alternative	Annual cost, in dollars, for 60 years at 6 percent
Service by a septic tank system for 60 year period	290
Septic tank system replaced by sewers after 15 years	297
Septic tank system replaced by sewers after 30 years	312
Initial construction of sewers	200

This comparison was made for a gross lot size of 1.5 acres, which is larger than the trend in the study area. Cotteral and Norris concluded that for lot sizes up to 3 acres, community sewerage collection and disposal are more economical than individual on-site disposal if adopted as the initial plan. Postponement and replacement at a later date are more costly. This finding corroborates the results developed above for North Spokane and Spokane Valley.

Evaluation of Other Concerns. Many of the concerns selected for evaluation of the action structural alternatives are not applicable

to the "no-action" plans. Therefore the following discussion of impacts of the "no-action" plans is directed selectively at those concerns which are judged to be most significant. Also, it is not useful to consider the "no-action" plan as a whole since each of the three elements can be implemented separately. Therefore, the discussion is directed to the North Spokane and the Spokane Valley elements separately. There is no need to discuss the City element since it is essentially equal to the action element C-sw which is part of Plan H.

North Spokane. The primary relevant concern is the relative impact this plan alternative will have on health, welfare and safety of the community. The North Spokane area is not uniformly suitable for drainfields and there are areas subject to failure and the emergence of septic tank effluent at the ground surface where it can be a threat to health. Due to the extreme depth to groundwater and the present level of knowledge about hazardous components of sewage that can pass through the soil, the threat to health via groundwater cannot be precisely defined. Of course the very fact that the septic tank effluent is in a position to physically threaten the groundwater is a greater potential impact than alternatives which completely remove this threat by disposal to other locations. The domestic use of groundwater downstream from the North Spokane area prior to its emergence as spring flow to the Little Spokane River is small compared to Spokane Valley.

The forecast density of development in North Spokane appears to be predicated upon a community sewage collection system. If on-site disposal is continued, lower densities will be required, so that the

"no-action" plan does effect the present proposed land use plan.

The potential for surface emergence of septic tank effluent and the possibility of it joining surface water runoff indicate a potential negative impact on surface water quality for the "no-action" plan.

The "no-action" plan has negligible energy requirements except for the periodic pumping of the septic tanks. Likewise the on-site disposal does not require chemicals. On the other hand the "no-action" plans do not lend themselves to energy or resource recovery. Septic tank pumpage, because it is difficult to draw only the stabilized material, usually contains significant amounts of putrescible materials. This limits the disposal options for this material without further processing. Disposal options are thus limited to disposal through a conventional treatment plant or to sanitary landfill. Land application for resource recovery has not been widely practiced.

Control of performance and monitoring of effluent from septic tanks and drainfields is difficult because of the large number of units. Performance depends upon original design and construction and periodic pumpage to prevent overflow of solids into the drainfield. The large number of units also mitigates any potential for adaptation to technological advances.

Individual on-site disposal provides the ultimate in flexibility to meet unexpected changes in rate of growth.

<u>Spokane Valley</u>. The almost uniform surface soil condition of high permeability makes Spokane Valley relatively free of drainfield failures with the consequent potential impacts on health due to surface

emergence or possible wash-off to surface water. In this respect, Spokane Valley does not have the potential health impact as North Spokane. On the other hand, the location of the Spokane Valley development above the primary aquifer at points upstream from its maximum use for domestic water supply gives it a much higher potential for health threat to groundwater than North Spokane.

For other concerns, Spokane Valley impacts are substantially as described above for North Spokane.

Summary Impacts of "No-Action". The impacts of continuing a policy of no action in North Spokane and Spokane Valley are summarized in Table 5. See Appendix II for typical format of narrative evaluation.

The general unreliability of drainfield performance in the North Spokane area has already lead to community action to phase out on-site disposal in favor of a collection system and community disposal. Since North Spokane is in a relatively early stage of development there are also strong economic incentives toward making the transition as soon as possible as demonstrated in the cited reference Cotteral and Norris (1969). The planned density of development also is dependent upon use of a sewage collection system. All of these reasons point to a recommendation that the "no-action" plan for North Spokane should be given a low ranking and that plans for internal sewage collection should be implemented to make the area ready for integration into one of the recommended action plans.

The general success of drainfields in the Spokane Valley as far as surface conditions are concerned, the high relative level of

development compared with forecast conditions, and the high cost of internal sewerage are factors favoring the no-action plan. Another factor which favors the no action plan, along with the various land application action plans, is that it avoids any surface water discharge of treated wastewater. The primary factor on which a decision must ultimately be made is the evaluation of the public health threat to groundwater. It is demonstrated in Section 608 that there is recharge of the groundwater by septic tank effluent and other surface applied waters in the Spokane Valley. A recommendation relative to the no action plan for Spokane Valley is postponed until there is a response from responsible public health officials to the implications of Section 608.

TABLE 1
SUMMARY RANKING OF CANDIDATE PLANS
BY CHARACTERISTICS AND CONCERNS

CHARACTERISTICS AND CONCERNS	Ranking of Candidate Plans** A	B	C	D	E	F	G	H
1. COST EFFECTIVENESS								
a. Present worth of the sum of capital and operation and maintenance costs	42.0	51.3	53.8	58.0	95.1	132.2	70.4	47.3
b. Is most cost effective	1	3	4	5	7	8	6	2
2. DIRECT ECONOMIC CONCERNS								
a. Has lowest requirement for capital	1	3	4	5	7	8	6	2
b. Has lowest annual O&M cost	5*	4*	6*	7*	2	1	3	8*
c. Causes minimum loss of employment and real income due to displacement	1*	3	1*	2	5	6	4	1*
d. Causes minimum loss of tax revenue due to displacement	2	5	1	4	7	8	6	3
3. INDIRECT ECONOMIC CONCERNS								
a. Has maximum favorable impact on attractiveness to business and rise in level of economic activity	1*	1*	1*	1*	2	3	1*	1*
4. TRANSIENT ECONOMIC CONCERNS								
a. Has maximum potential for local employment increase during construction	7	5	6	4	2	1	3	8
b. Has maximum potential for increase in local manufacture and supply activity during construction	7	6	5	4	2	1	3	8
c. Will cause minimum disruption of circulation and business activity during construction	2	3	5	4*	4*	4*	4*	1
5. SOCIAL CONCERNS FOR THE COMMUNITY								
a. Has most favorable impact on health, welfare and safety	2*	2*	3*	1*	3*	1*	3*	3*
b. Causes the least disruption to existing community living patterns	1*	3	1*	2	5	6	4	1*
c. Has the most beneficial impact on availability of recreation	7	6	5	3	2	1	4	8
d. Introduces the least constraints to land use and land use planning	1*	3	1*	2	5	6	4	1*
6. SOCIAL CONCERNS FOR THE INDIVIDUAL								
a. Causes the least dislocation of individuals from their homes, employment and general pattern of cultural activity	1*	3	1*	2	5	6	4	1*
7. CONCERNS FOR GROUNDWATER								
a. Provides maximum protection of groundwater quality	4*	5	1	7	6	2	3	4*
8. CONCERNS FOR SURFACE WATER								
a. Provides maximum protection or enhancement of surface water quality for all concerns	6	6	5	4	2	1	3	7
9. CONCERNS FOR LAND USE								
a. Preserves or increases land available for wildlife habitat, natural vegetation and open space	2	4	1	7	5	6	8	3
b. Preserves or enhances the aesthetic value of the landscape	2	4	1	7	5	6	8	3
c. Creates least interference with other beneficial uses of land	2	4	1	8	6	5	7	3
10. CONCERNS FOR AIR QUALITY								
a. Provides maximum protection of public health aspects of air quality	1*	2	1*	1*	4	4	3	1*
b. Provides minimum potential for deterioration of aesthetic quality of air	2	4	1	5	8	6	7	3
11. CONCERNS FOR ENERGY AND RESOURCES								
a. Requires minimum input of 10^6 kwh electrical energy	407 1	438 2	489 4	556 5	921 7	1281 8	620 6	441 3
b. Requires minimum input of chemicals	4*	3	4*	5	1*	1*	2	4*
c. Provides the maximum opportunity for energy and resource recovery	1*	1*	1*	2*	2*	1*	2*	1*
d. Has lowest net energy requirement considering recovery	1	2*	3	4	6	7	5	2*
12. PERFORMANCE EVALUATION								
a. Provides best technical performance in wastewater renovation	7	6	5	3	4	1	2	8
b. Provides highest degree of reliability	7	6	5	3	4	1	2	8
13. FLEXIBILITY								
a. Has maximum flexibility to meet unanticipated changes in growth	3	2	7	4	6	8	5	1
b. Has maximum flexibility in adapting to changes in disposal criteria	6	3*	5	3*	4	1	2	7
c. Has maximum flexibility to incorporate changes in technology of wastewater treatment	3*	4	5	3*	2*	2*	1	6

*Indicates small or insignificant difference in ranking.
**Rankings are relative, in order, from 1, highest ranked, to 8, lowest ranked.

TABLE 2A
RANKING OF GROUP 1 CONCERNS
HEAVILY WEIGHTED TO COST

CONCERN	WEIGHT	A Rel[1]	A Wtd[2]	B Rel	B Wtd	C Rel	C Wtd	D Rel	D Wtd	E Rel	E Wtd	F Rel	F Wtd	G Rel	G Wtd	H Rel	H Wtd
		Weighted Ranking of Candidate Plans															
1a. Has lowest total cost for the planning period	65	1.000	65.0	.819	53.24	.781	50.76	.724	47.06	.442	28.73	.318	20.67	.597	38.80	.888	57.72
2d. Causes minimum loss of tax revenue	7	1.000	7.0	.075	0.52	1.000	7.0	.081	0.57	.020	0.14	.008	0.06	.024	0.17	1.000	7.0
5b. Causes least disruption to community living patterns	3	1.000	3.0	.8	2.4	1.000	3.0	.9	2.7	.5	1.5	.4	1.2	.7	2.1	1.000	3.0
7a. Provides maximum protection of groundwater quality	10	.85	8.50	.80	8.00	1.000	10.0	.40	4.0	.80	8.0	.95	9.5	.90	9.0	.85	8.5
8a. Provides maximum protection of surface water quality	10	.40	4.0	.40	4.0	.45	4.5	.60	6.0	.75	7.5	1.000	10.0	.70	7.0	.35	3.5
11d. Has lowest net energy requirement	3	1.000	3.0	.886	2.66	.768	2.30	.552	1.66	.316	0.95	.235	0.70	.491	1.47	.447	1.34
12a. Provides best technical performance of wastewater renovation	1	.50	0.50	.55	0.55	.60	0.60	.85	0.85	.75	0.75	1.000	1.0	.90	0.90	.48	0.48
13a. Has maximum flexibility for unanticipated growth	1	.85	0.85	.90	0.90	.40	0.40	.75	0.75	.50	0.50	.35	0.35	.65	0.65	1.000	1.0
TOTALS	100				72.27		78.56		63.59		48.07		43.48		60.09		82.54

[1]Relative ranking within each concern.
[2]Weighted ranking, the product of relative ranking and concern weight.

TABLE 2B
RANKING OF GROUP 1 CONCERNS
MODERATELY WEIGHTED TO COST

CONCERN	WEIGHT	Weighted Ranking of Candidate Plans: A Rel[1]	A Wtd[2]	B Rel	B Wtd	C Rel	C Wtd	D Rel	D Wtd	E Rel	E Wtd	F Rel	F Wtd	G Rel	G Wtd	H Rel	H Wtd
1a. Has lowest total cost for the planning period	50	1.000	50.00	.819	40.95	.781	39.05	.724	36.20	.442	22.10	.318	15.90	.597	29.85	.888	44.40
2d. Causes minimum loss of tax revenue	10	1.000	10.0	.075	0.75	1.000	10.0	.081	0.81	.020	0.20	.008	0.08	.024	0.24	1.000	10.0
5b. Causes least disruption to community living patterns	3	1.000	3.0	.8	2.4	1.000	3.0	.9	2.7	.5	1.5	.4	1.2	.7	2.1	1.000	3.0
7a. Provides maximum protection of groundwater quality	15	.85	12.75	.80	12.0	1.000	15.0	.40	6.0	.80	12.0	.95	14.25	.90	13.5	.85	12.75
8a. Provides maximum protection of surface water quality	15	.40	6.0	.40	6.0	.45	6.75	.60	9.0	.75	11.25	1.000	15.0	.70	10.5	.35	5.25
11d. Has lowest net energy requirement	3	1.000	3.0	.886	2.66	.768	2.30	.552	1.66	.316	0.95	.235	0.70	.491	1.47	.447	1.34
12a. Provides best technical performance of wastewater renovation	2	.50	1.0	.55	1.1	.60	1.2	.85	1.7	.75	1.5	1.000	2.0	.90	1.8	.48	0.96
13a. Has maximum flexibility for unanticipated growth	2	.85	1.70	.90	1.8	.40	0.8	.75	1.5	.50	1.0	.35	0.7	.65	1.3	1.000	2.0
TOTALS	100		87.45		67.66		78.10		59.57		50.50		49.83		60.76		79.70

[1]Relative ranking within each concern.
[2]Weighted ranking, the product of relative ranking and concern weight.

TABLE 2C
RANKING OF GROUP 1 CONCERNS
MODERATELY WEIGHTED TO WATER QUALITY

		Weighted Ranking of Candidate Plans															
		A		B		C		D		E		F		G		H	
CONCERN	WEIGHT	Rel[1]	Wtd[2]	Rel	Wtd	Rel	Wtd	Rel	Wtd	Rel	Wtd	Rel	Wtd	Rel	Wtd	Rel	Wtd
1a. Has lowest total cost for the planning period	30	1.000	30.0	.819	24.57	.781	23.43	.724	21.72	.442	13.26	.318	9.54	.597	17.91	.888	26.64
2d. Causes minimum loss of tax revenue	6	1.000	6.0	.075	.45	1.000	6.0	.081	0.49	.020	0.12	.008	0.05	.024	0.14	1.000	6.0
5b. Causes least disruption to community living patterns	5	1.000	5.0	.8	4.0	1.000	5.0	.9	4.5	.5	2.5	.4	2.0	.7	3.5	1.000	5.0
7a. Provides maximum protection of groundwater quality	20	.85	17.0	.80	16.0	1.000	20.0	.40	8.0	.80	16.0	.95	19.0	.90	18.0	.85	17.0
8a. Provides maximum protection of surface water qualtiy	20	.40	8.0	.40	8.0	.45	9.0	.60	12.0	.75	15.0	1.000	20.0	.70	14.0	.35	7.0
11d. Has lowest net energy requirement	7	1.000	7.0	.886	6.20	.768	5.38	.552	3.86	.316	2.21	.235	1.65	.491	3.44	.447	3.13
12a. Provides best technical performance of wastewater renovation	7	.50	3.50	.55	3.85	.60	4.20	.85	5.95	.75	5.25	1.000	7.00	.90	6.30	.48	3.36
13a. Has maximum flexibility for unanticipated growth	5	.85	4.25	.90	4.50	.40	2.0	.75	3.75	.50	2.50	.35	1.75	.65	3.25	1.000	5.0
TOTALS	100		80.75		67.57		75.01		60.27		56.84		60.99		66.54		73.13

[1]Relative ranking within each concern.
[2]Weighted ranking, the product of relative ranking and concern weight.

TA[illegible] 2D
RANKING OF GROUP 1 CONCERNS
HEAVILY WEIGHTED TO WATER QUALITY

		Weighted Ranking of Candidate Plans															
		A		B		C		D		E		F		G		H	
CONCERN	WEIGHT	Rel[1]	Wtd[2]	Rel	Wtd	Rel	Wtd	Rel	Wtd	Rel	Wtd	Rel	Wtd	Rel	Wtd	Rel	Wtd
1a. Has lowest total cost for the planning period	20	1.000	20.0	.819	16.38	.781	15.62	.724	14.48	.442	8.84	.318	6.36	.597	11.94	.888	17.76
2a. Causes minimum loss of tax revenue	5	1.000	5.00	.075	0.38	1.000	5.0	.081	0.40	.020	0.10	.008	0.04	.024	0.12	1.000	5.0
5b. Causes least disruption to community living patterns	5	1.000	5.0	.8	4.0	1.000	5.0	.9	4.5	.5	2.5	.4	2.0	.7	3.5	1.000	5.0
7a. Provides maximum protection of groundwater quality	25	.85	21.25	.80	20.0	1.000	25.0	.40	10.0	.80	20.0	.95	23.75	.90	22.5	.85	21.25
8a. Provides maximum protection of surface water quality	25	.40	10.0	.40	10.0	.45	11.25	.60	15.0	.75	18.75	1.000	25.0	.70	17.5	.35	8.75
11d. Has lowest net energy requirement	7	1.000	7.0	.886	6.20	.768	5.38	.552	3.86	.316	2.21	.235	1.64	.491	3.44	.447	3.13
12a. Provides best technical performance of wastewater renovation	10	.50	5.0	.55	5.5	.60	6.0	.85	8.5	.75	7.5	1.000	10.0	.90	9.0	.48	4.8
13a. Has maximum flexibility for unanticipated growth	3	.85	2.55	.90	2.7	.40	1.2	.75	2.25	.50	1.5	.35	1.05	.65	1.95	1.000	3.0
TOTALS	100		75.80		65.16		74.45		58.99		61.40		69.84		69.95		68.69

[1]Relative ranking within each concern.
[2]Weighted ranking, the product of relative ranking and concern weight.

TABLE 3A
RANKING OF GROUP 2 CONCERNS
WEIGHTED TOWARD ECONOMIC VALUES

Weighted Toward Economic CONCERN	WEIGHT	A Rel[1]	A Wtd[2]	B Rel	B Wtd	C Rel	C Wtd	D Rel	D Wtd	E Rel	E Wtd	F Rel	F Wtd	G Rel	G Wtd	H Rel	H Wtd
		Weighted Ranking of Candidate Plans															
2c. Causes minimum loss of employment and real income	10	1.00	10.0	.75	7.5	1.00	10.0	.90	9.0	.60	6.0	.45	4.5	.70	7.0	1.00	10.0
3a. Has maximum favorable impact on business and economic activity	10	1.00	10.0	1.00	10.0	1.00	10.0	1.00	10 0	.85	8.5	.70	7.0	1.00	10.0	1.00	10.0
4a. Has maximum potential for local employment during construction	10	.09	0.9	.17	1.7	.16	1.6	.20	2.0	.68	6.8	1.00	10.0	.40	4.0	.08	0.8
4b. Has maximum potential for local manufacturing and supply during construction	10	.10	1.0	.16	1.6	.18	1.8	.20	2.0	.70	7.0	1.00	10.0	.37	3.7	.10	1.0
4c. Will cause minimum disruption during construction	10	.90	9.0	.70	7.0	.20	2.0	50	5.0	.50	5.0	.50	5.0	.50	5.0	1.00	10.0
5a. Has most favorable impact on health safety and welfare	4	.80	3.2	.80	3.2	70	2.8	1.00	4.0	.70	2.8	1.00	4.0	.70	2.8	.70	2.8
5c. Has most beneficial impact on availability of recreation	2	.50	1.0	.60	1.2	.65	1.3	.75	1.5	.90	1.8	1.00	2.0	.70	1.4	.48	0.96
5d. Introduces least constraints to land use and planning	5	1.00	5.0	.65	3.25	1.00	5.0	75	3.75	.30	1.5	.25	1.25	.60	3.0	1.00	5.0
6a. Causes least dislocation of individuals	2	1.00	2.0	.80	1.6	1.00	2.0	.90	1.8	.50	1.0	.40	0.8	.70	1.4	1.00	2.0
9a. Preserves or increases land available for habitat or open space	2	.90	1.8	75	1.5	1 00	2.0	.60	1.2	.70	1.4	.65	1.3	.58	1.16	.85	1.70
9b. Preserves or enhances aesthetic value of landscape	2	.95	1.9	.80	1.6	1 00	2.0	.65	1 3	.78	1.56	.70	1.4	.60	1.2	.93	1.86
9c. Creates least interference with other beneficial use of land	5	.95	4 75	.75	3.75	1.00	5.0	.60	3.0	.68	3.4	.70	3.5	.65	3.25	.93	4.65
10a. Provides maximum protection of health aspects of air quality	2	1.00	2.0	.75	1.5	1 00	2.0	1.00	2 0	.30	0.6	.30	0.6	.65	1.3	1.00	2.0
10b. Provides minimum potential for deterioration of aesthetic quality of air	1	.85	0.85	.70	0.7	1.00	1.0	.65	0.65	.50	0.5	.60	0.6	.55	0.55	.75	0.75
11b. Require minimum input of chemicals	10	.20	2.0	.25	2.5	.20	2.0	.18	1 8	1.00	10.0	1.00	10.0	.30	3.0	.20	2.0
12b. Provides highest degree of reliability	7	.45	3.15	50	3.5	.55	3.85	.70	4 9	60	4.2	1.00	7.0	.80	5.6	.40	2.8
13b. Has maximum flexibility to meet changes in disposal criteria	4	[illegible]	1 6	[illegible]	[illegible]	.50	2 0	70	2 8	55	2 2	1.00	4.0	.80	3.2	.40	1.6
13c. Has maximum flexibility to incorporate changes in technology	4	80	3 2	.70	2 8	60	2 4	80	3 2	.90	3 6	.90	3.6	1 00	4.0	50	2.0
TOTALS	100		63 55		57 70		58 75		59 90		67 86		76.55		61.56		61 92

TABLE 3B
RANKING OF GROUP 2 CONCERNS
WEIGHTED TOWARD ENVIRONMENTAL AND SOCIAL CONCERNS

Weighted Toward Environmental and Social Concerns		Weighted Ranking of Candidate Plans															
		A		B		C		D		E		F		G		H	
CONCERN	WEIGHT	Rel[1]	Wtd[2]	Rel	Wtd	Rel	Wtd	Rel	Wtd	Rel	Wtd	Rel	Wtd	Rel	Wtd	Rel	Wtd
2c. Causes minimum loss of employment and real income	3	1.00	3.0	.75	2.25	1.00	3.0	.90	2.7	.60	1.8	.45	1.35	.70	2.1	1.00	3.0
3a. Has maximum favorable impact on business and economic activity	2	1.00	2.0	1.00	2.0	1.00	2.0	1.00	2.0	.85	1.7	.70	1.4	1.00	2.0	1.00	2.0
4a. Has maximum potential local employment during construction	1	.09	0.09	.17	0.17	.16	0.16	.20	0.20	.68	0.68	1.00	1.0	.40	0.40	.08	0.08
4b. Has maximum potential for local manufacturing and supply during construction	1	.10	0.10	.16	0.16	.18	0.18	.20	0.20	.70	0.70	1.00	1.0	.37	0.37	.10	0.10
4c. Will cause minimum disruption during construction	7	.90	6.3	.70	4.9	.20	1.4	.50	3.5	.50	3.5	1.50	3.5	.50	3.5	1.00	7.0
5a. Has most favorable impact on health safety and welfare	8	.80	6.4	.80	6.4	.70	5.6	1.00	8.0	.70	5.6	1.00	8.0	.70	5.6	.70	5.6
5c. Has most beneficial impact on availability of recreation	8	.50	4.0	.60	4.8	.65	5.2	.75	0.60	.90	7.2	1.00	8.0	.70	5.6	.48	3.84
5d. Introduces least constraints to land use and planning	6	1.00	6.0	.65	3.9	1.00	6.0	.75	4.5	.30	1.8	.25	1.5	.60	3.6	1.00	6.0
6a. Causes least dislocation of individuals	7	1.00	7.0	.80	5.6	1.00	7.0	.90	6.3	.50	3.5	.40	2.8	.70	4.9	1.00	7.0
9a. Preserves or increases land available for habitat or open space	9	.90	8.1	.75	6.75	1.00	9.0	.60	5.4	.70	6.3	.65	5.85	.58	5.22	.85	7.65
9b. Preserves or enhances aesthetic value of landscape	7	.95	6.65	.80	5.6	1.00	7.0	.65	4.55	.78	5.46	.70	4.9	.60	4.2	.93	6.51
9c. Creates least interference with other beneficial use of land	4	.95	3.8	.75	3.0	1.00	4.0	.60	2.4	.68	2.72	.70	2.8	.65	2.6	.93	3.72
10a. Provides maximum protection of health aspects of air quality	8	1.00	8.0	.75	6.0	1.00	8.0	1.00	8.0	.30	2.4	.30	2.4	.65	5.2	1.00	8.0
10b. Provides minimum potential for deterioration of aesthetic quality of air	7	.85	5.95	.70	4.9	1.00	7.0	.65	4.55	.50	3.5	.60	4.2	.55	3.85	.75	5.25
11b. Requires minimum input of chemicals	2	.20	0.4	.25	0.5	.20	0.4	.18	0.36	1.00	2.0	1.00	2.0	.30	0.6	.20	0.4
12b. Provides highest degree of reliability	9	.45	4.05	.50	4.5	.55	4.95	.70	6.3	.60	5.4	1.00	9.0	[illegible]	7.2	.40	3.6
13b. Has maximum flexibility to meet changes in disposal criteria	6	.4[illegible]	2.7	.70	4.2	.50	3.0	.70	4.2	.55	3.3	1.00	6.0	.80	4.8	.40	2.4
13c. Has maximum flexibility to incorporate changes in technology	5	.80	4.0	.70	3.5	.60	3.0	.80	4.0	.90	4.5	.90	4.5	1.00	5.0	.50	2.5
TOTALS	100		78.54		69.13		76.89		67.76		62.06		70.20		66.74		74.65

TABLE 3C
RANKING OF GROUP 2 CONCERNS
BALANCED WEIGHTING

Balanced CONCERN	WEIGHT	Weighted Ranking of Candidate Plans: A Rel[1]	A Wtd[2]	B Rel	B Wtd	C Rel	C Wtd	D Rel	D Wtd	E Rel	E Wtd	F Rel	F Wtd	G Rel	G Wtd	H Rel	H Wtd
2c. Causes minimum loss of employment and real income	6	1.00	6.0	.75	4.5	1.00	6.0	.90	5.4	.60	3.6	.45	2.7	.70	4.2	1.00	6.0
3a. Has maximum favorable impact on business and economic activity	5	1.00	5.0	1.00	5.0	1.00	5.0	1.00	5.0	.85	4.25	.70	3.5	1.00	5.0	1.00	5.0
4a. Has maximum potential local employment during construction	5	.09	0.45	.17	0.85	.16	0.80	.20	1.0	.68	3.4	1.00	5.0	.40	2.0	.08	0.40
4b. Has maximum potential for local manufacturing and supply during construction	5	.10	0.5	.16	0.80	.18	0.90	.20	1.0	.70	3.5	1.00	5.0	.37	1.85	.10	0.50
4c. Will cause minimum disruption during construction	7	.90	6.3	.70	4.9	20	1.4	.50	3.5	.50	3.5	1.50	3.5	.50	3.5	1.00	7.0
5a. Has most favorable impact on health safety and welfare	5	.80	4.0	.80	4.0	70	3 5	1.00	5.0	70	3.5	1.00	5.0	.70	3.5	.70	3.5
5c. Has most beneficial impact on availability of recreation	5	.50	2.5	.60	3.0	.65	3.25	.75	3.75	.90	4.5	1.00	5.0	.70	3.5	.48	2.4
5d. Introduces least constraints to land use and planning	5	1.00	5.0	.65	3 25	1.00	5.0	75	3.75	.30	1.5	.25	1.25	.60	3.0	1.00	5.0
6a. Causes least dislocation of individuals	5	1.00	5.0	.80	4.0	1 00	5 0	.90	4.5	50	2.5	.40	2.0	.70	3.5	1.00	5.0
9a. Preserves or increases land available for habitat or open space	5	.90	4.5	.75	3.75	1.00	5.0	.60	3.0	.70	3.5	.65	3.25	.58	2.9	.85	4.25
9b. Preserves or enhances aesthetic value of landscape	5	.95	4.75	.80	4.0	1 00	5.0	.65	3.25	.78	3.9	.70	3.5	.60	3.0	.93	4.65
9c. Creates least interference with other beneficial use of land	5	.95	4.75	.75	3.75	1.00	5.0	.60	3.0	.68	3.4	70	3.5	.65	3.25	.93	4.65
10a. Provides maximum protection of health aspects of air quality	7	1.00	7.0	.75	5.25	1.00	7.0	1.00	7.0	.30	2.1	.30	2.1	.65	4.55	1.00	7.0
10b. Provides minimum potential for deterioration of aesthetic quality of air	5	.85	4.25	.70	3.5	1 00	5.0	.65	3.25	.50	2.5	.60	3.0	.55	2.75	.75	3.75
11b. Requires minimum input of chemicals	7	.20	1.4	.25	1.75	.20	1.4	.18	1.26	1.00	7 0	1.00	7.0	.30	2.1	.20	1.4
12b. Provides highest degree of reliability	8	.45	3.6	.50	4.0	55	4 4	.70	5.6	.60	4.8	1.00	8.0	.80	6.4	.40	3.2
13b. Has maximum flexibility to meet changes in disposal criteria	5	45	2.25	70	3 5	50	2 5	70	3.5	55	2.75	1.00	5.0	.80	4.0	.40	2.0
13c. Has maximum flexibility to incorporate changes in technology	5	.80	4.0	.70	3.5	.60	3.0	80	4.0	.90	4.5	90	4.5	1 00	5.0	.50	2.5
TOTALS	100		71.25		63.30		69.15		66.76		64.70		72.80		64.00		68.20

TABLE 4
SUMMARY RANKING OF GROUP 1 AND GROUP 2 CONCERNS

	1983 STANDARDS ONLY					1985 STANDARDS		
	A	B	C	E	H	D	F	G
GROUP 1 CONCERNS								
A. Heavily weighted to cost	91.85	72.27	78.56	48.07	82.54	63.59	43.48	60.09
B. Moderately weighted to cost	87.45	67.66	78.10	50.50	79.70	59.57	49.83	60.76
C. Moderately weighted to water quality	80.75	67.57	75.01	56.84	73.13	60.27	60.99	66.54
D. Heavily weighted to water quality	75.80	65.16	74.45	61.40	68.69	58.99	69.84	69.95
GROUP 2 CONCERNS								
A. Weighted to economics	63.55	57.70	58.75	67.86	61.92	59.90	76.55	61.56
B. Weighted to environmental-social	78.54	69.13	76.89	62.06	74.65	67.76	70.20	66.74
C. Balanced	71.25	63.30	69.15	64.70	68.20	66.76	72.80	64.00
COMBINED GROUPS								
0.75 x 1A + 0.25 x 2A	84.78	68.63	73.61	53.02	77.39	62.67	51.75	60.46
0.75 x 1B + 0.25 x 2C	83.40	66.57	75.86	54.05	76.83	61.37	55.57	61.57
0.75 x 1C + 0.25 x 2C	78.37	66.50	73.55	58.81	71.90	61.89	63.94	65.90
0.75 x 1D + 0.25 x 2B	76.49	66.15	75.06	61.57	70.18	61.18	69.93	69.15
0.90 x 1A + 0.10 x 2A	89.02	70.81	76.58	50.05	80.48	63.22	46.79	60.24
0.90 x 1B + 0.10 x 2C	85.83	67.22	77.20	51.92	78.55	60.29	52.13	61.08
0.90 x 1C + 0.10 x 2C	79.80	67.14	74.42	57.63	72.64	60.92	62.17	66.29
0.90 x 1D + 0.10 x 2B	76.07	65.56	74.69	61.47	69.29	59.87	69.88	69.63

TABLE 5
SUMMARY IMPACTS OF THE NO-ACTION PLAN
FOR NORTH SPOKANE AND SPOKANE VALLEY

Concerns	North Spokane	Spokane Valley
The no action plan will cost how much less than the lowest cost action plan for this element?	$25,100,000*	$51,700,000*
What is potential for health threat due to surface emergence from failed drainfields?	High	Low
What is potential for health threat due to groundwater recharge?	Moderate	High
How do no-action plans compare with action plans regarding energy and chemical requirements?	Negligibly low	
Do no-action plans provide any potential for energy or resource recovery?	None	
How does on-site disposal rank relative to community systems for flexibility to take advantage of technological advances?	Low	
How does on-site disposal rank relative to community systems for flexibility to meet unexpected changes in growth rate.	High	

*Expressed as net present worth for the 1980-2000 planning period.

TABLE 6

SUMMARY RANKING OF SUBALTERNATIVES FOR UPGRADE OF PLAN A

CHARACTERISTICS AND CONCERNS	Ranking of Candidate Plans D	F-1	J
1. COST EFFECTIVENESS			
a. Present worth of the sum of capital (1) and operation and maintenance costs	58.0	81.9	70.9
b. Is most cost effective	1	3	2
2. DIRECT ECONOMIC CONCERNS			
a. Has lowest requirement for capital (1)	29.3	57.5	32.0
b. Has lowest annual O&M cost (1)	28.7	24.4	38.9
c. Causes minimum loss of employment and real income due to displacement	2	3	1
d. Causes minimum loss of tax revenue due to displacement	2	3	1
3. INDIRECT ECONOMIC CONCERNS			
a. Has maximum favorable impact on attractiveness to business and rise in level of economic activity	1	3	2
4. TRANSIENT ECONOMIC CONCERNS			
a. Has maximum potential for local employment increase during construction	2	1	3
b. Has maximum potential for increase in local manufacture and supply activity during construction	2	1	3
c. Will cause minimum disruption of circulation and business activity during construction	2	3	1
5. SOCIAL CONCERNS FOR THE COMMUNITY			
a. Has most favorable impact on health, welfare and safety	2	3	1
b. Causes the least disruption to existing community living patterns	2	3	1
c. Has the most beneficial impact on availability of recreation	3	2	1
d. Introduces the least constraints to land use and land use planning	2	3	1
6. SOCIAL CONCERNS FOR THE INDIVIDUAL			
a. Causes the least dislocation of individuals from their homes, employment and general pattern of cultural activity	2	3	1
7. CONCERNS FOR GROUNDWATER			
a. Provides maximum protection of groundwater quality	3	2	1
8. CONCERNS FOR SURFACE WATER			
a. Provides maximum protection or enhancement of surface water quality for all concerns	1	1	2
9. CONCERNS FOR LAND USE			
a. Preserves or increases land available for wildlife habitat, natural vegetation and open space	2	3	1
b. Preserves or enhances the aesthetic value of the landscape	2	3	1
c. Creates least interference with other beneficial uses of land	2	3	1
10. CONCERNS FOR AIR QUALITY AND NOISE			
a. Provides maximum protection of public health aspects of air quality	1	2	1
b. Provides minimum potential for offensive odors	2	3	1
c. Provides minimum noise impact	-	-	-
11. CONCERNS FOR ENERGY AND RESOURCES			
a. Requires minimum input of electrical energy (2)	556	844	675
b. Requires minimum input of chemicals	2	1	3
c. Provides the maximum opportunity for energy and resource recovery	1	1	2
d. Has lowest net energy requirement considering recovery (2)	493	709	540
12. PERFORMANCE EVALUATION			
a. Provides best technical performance in wastewater renovation	2	1	1
b. Provides highest degree of reliability	1	2	3
13. FLEXIBILITY			
a. Has maximum flexibility to meet unanticipated changes in growth	2	3	1
b. Has maximum flexibility in adapting to changes in disposal criteria	2	1	1
c. Has maximum flexibility to incorporate changes in technology of wastewater treatment	2	3	1

(1) Present worth, millions of dollars over 20-year planning period
(2) Cumulative energy use 10^6 kwh over 20-year planning period

TABLE 7

RANKING OF GROUP 1 CONCERNS
OF SUBALTERNATIVES FOR UPGRADE OF PLAN A
MODERATELY WEIGHTED TO COST

			Weighted Ranking of Candidate Plans					
			D		F-1		J	
CONCERN		WEIGHT	Rel[1]	Wtd[2]	Rel	Wtd	Rel	Wtd
1a.	Has lowest total cost for the planning period	50	1.0	50.	.71	35.5	.82	41.0
2d.	Causes minimum loss of tax revenue	10	.7	7.0	.2	2.0	1.00	10.0
5b.	Causes least disruption to community living patterns	3	.7	2.1	.3	.9	1.00	3.0
7a.	Provides maximum protection of groundwater quality	15	.7	10.5	.95	14.3	1.00	15.0
8a.	Provides maximum protection of surface water quality	15	1.00	15.0	1.00	15.0	.90	13.5
11d.	Has lowest net energy requirement	3	1.00	3.0	.70	2.1	.91	2.7
12a.	Provides best technical performance of wastewater renovation	2	.75	1.5	1.00	2.0	.95	1.9
13a.	Has maximum flexibility for unanticipated growth	2	.8	1.6	.6	1.2	1.00	2.0
	TOTALS	100		90.7		73.0		89.1

[1]Relative ranking within each concern.
[2]Weighted ranking, the product of relative ranking and concern weight.

TABLE 8

RANKING OF GROUP 1 CONCERNS
FOR SUBALTERNATIVES FOR UPGRADE OF PLAN A
MODERATELY WEIGHTED TO WATER QUALITY

CONCERN		WEIGHT	Weighted Ranking of Candidate Plans					
			D		F-1		J	
			Rel[1]	Wtd[2]	Rel	Wtd	Rel	Wtd
1a.	Has lowest total cost for the planning period	30	1.00	30.0	.71	21.0	.82	24.5
2d.	Causes minimum loss of tax revenue	6	.7	4.2	.2	1.2	1.00	6.0
5b.	Causes least disruption to community living patterns	5	.7	3.5	.3	1.5	1.00	5.0
7a.	Provides maximum protection of groundwater quality	20	.7	14.0	.95	19.0	1.00	20.0
8a.	Provides maximum protection of surface water quality	20	1.00	20.0	1.00	20.0	.90	18.0
11d.	Has lowest net energy requirement	7	1.00	7.0	.70	4.9	.91	6.4
12a.	Provides best technical performance of wastewater renovation	7	.75	5.3	1.00	7.0	.95	6.7
13a.	Has maximum flexibility for unanticipated growth	5	.8	4.0	.6	3.0	1.0	5.0
	TOTALS	100		88.0		77.6		91.6

[1] Relative ranking within each concern.
[2] Weighted ranking, the product of relative ranking and concern weight.

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APPENDIX I

Preliminary Geological Report
on Storage Reservoir Sites

PRUFER SITE (28/41-30)

1. GENERAL

The Prufer site is located in a northeast trending, broad, flat-bottomed valley nearly surrounded by pre-Tertiary granitic highlands. The valley bottom is filled with Quaternary glacial lake sediments consisting of interlayered sand and clay deposits. Sketchy records of wells in the valley indicate the interlayering is irregular and discontinuous. The thickest clay layer specifically recorded is 3 ft. The surface soils within the valley probably consist of silt and sand.

The granite abutment areas have been surficially weathered to unknown depths, but in nearby outcrops the weathering is less than 10 ft. deep. The typical granite in this area is massive to moderately jointed.

2. RESERVOIR PERMEABILITY

Reservoir bottom permeability would probably be moderate to high, depending upon the horizontal continuity and thickness of the clay layers. In our opinion, only minimal leakage would occur from the rock enclosed basin. However, leakage into the area groundwater system could occur northward beneath or around the dam, and could join the groundwater systems beneath the Mud Creek and Dragoon Creek drainages. Local groundwater depths in the area are relatively shallow, being generally less than 15 ft. within the proposed reservoir. Granitic outcrops near the site indicate the possibility of subsurface groundwater barriers that may influence the extent of groundwater movement.

3. FOUNDATION CONSIDERATIONS

The depth, extent and physical characteristics of interlayered clays may influence foundation design, although the in situ glacial lake sand should be adequate to support an earth or rock fill dam.

No organic or highly compressible soils appear to be present beneath the dam site, based upon available data. Surface stripping for the main embankment (other than cutoff) should be minimal.

Control of seepage beneath the dam may require a positive cutoff,

partial cutoff, or upstream blanketing, depending in part on overburden depths.

4. EMBANKMENT MATERIALS

Adequate quantities of pervious lacustrine sands appear to be present within the central portion of the reservoir area. Impervious deposits of silt and clay occur near the edge of the granite highlands to the south of the reservoir. The suitability, quantity or depth of these materials is unknown. Relatively impervious clayey sands from residual and slopewash deposits occur on the lower slopes of the surrounding highlands and, although depths are relatively shallow (estimate - less than 15 ft.), total quantities adjacent to the reservoir may be adequate.

Both basalt and granitic rock materials are locally available (within 2 miles), but surficially weathered materials would need to be excavated before hard, fresh rock could be quarried. The granites are relatively massive and would require extensive shooting in our opinion.

5. EMBANKMENT SLOPES

The type of materials that appear to be available near the Prufer site indicate that either an earthfill dam (zoned or homogeneous) or a modified, zoned rock fill dam could be constructed. For an earthfill structure, we recommend that, for preliminary evaluation, you assume that embankment slopes will be in the order of 3:1 (3 horizontal to 1 vertical) upstream and 2.5:1 downstream. Embankment slopes for a modified rock fill dam (possibly impervious upstream shell) would be in the order of 2.5:1 upstream, with the downstream slope near 1.4:1.

Preliminary Damsite Review
Spokane River Basin

OLD TRAILS SITE (25/42-5)

1. GENERAL

The site is located in a northward trendi g, reentrant canyon which is tributary to the Spokane River Gorge. The canyon cuts into the uppermost flows of the Columbia Plateau basalt that rim the gorge in this area. Before a recent line relocation, the Burlington Northern Railroad routed their main line through the Old Trails Canyon.

The upper abutment areas of the proposed dam will be on or near the basalt flow rock. However, the sides and bottom of the canyon may, in our opinion, have overburden deposits of unconsolidated silt, sand, gravel and talus. Depths of the overburden are unknown, but probably extend several tens of feet. From available information at nearby Deep Creek and Indian Canyons, the overburden probably consists of unconsolidated, clean to silty glacial outwash gravels; stratified sands; accumulations of angular basalt talus and "haystack" blocks, possibly resting on hard silt and clay of the Latah formation; and silty colluvial mixtures of these materials.

2. RESERVOIR PERMEABILITY

The unconsolidated overburden soils, in our opinion, have moderate to very rapid permeability. Therefore, a cutoff or upstream blanket would probably be necessary to minimize seepage from the reservoir. Typically, the basalt which appears to underlie the unconsolidated overburden and which would probably form the dam abutments is moderately to highly jointed. The jointing is generally discontinuous and often relatively tight, so that only minimal leakage through the rock would be expected. However, some jointing and flow contact zones in basalt have been known to permit passage of large quantities of water. The presence of such features should be determined by direct observation and exploration.

Controlled seepage from the reservoir would probably surface in the canyon downstream of the dam, run down the stream bed, and disappear into river terrace gravels which underlie the Camp Seven Mile military reservation. The water would probably eventually find its way into the Spokane River. No known important groundwater aquifers would be involved, in our opinion.

comparative evaluation with other alternatives. For the purpose of this level of evaluation, it is judged that preempting of any large scale area for irrigation with reclaimed wastewater constitutes a negative impact with respect to dislocation of people and disruption of accustomed patterns. Specific sites differ in the degree of potential dislocation due to the differing densities of present occupation. Relatively large ownerships, averaging 160 acres or more predominate in all three areas.

Due to the lower existing intensity of agriculture in the Airways Heights area, disruptive potential is evaluated lowest of the three sites. Williams Valley is ranked second lowest due to the fact that the use under irrigated conditions is practically the same as at present. The Peone Prairie is ranked as having the highest disruptive potential due to the change in crops.

The eastern part of the Spokane Valley is not used as an irrigation site in any of the developed plan alternatives for reasons discussed elsewhere. It should be noted, however, that another reason for not using the Spokane Valley as a disposal site is its potential for a very high degree of disruption due to land ownership in relatively small holdings of diverse use.

Cost effectiveness analysis does not include a cost item for relocation, only the land value is charged. Experience in one site where a large scale land acquisition was made for wastewater irrigation (Muskegon County, Michigan) indicated that relocation costs added 20 percent to land costs.

3. FOUNDATION CONSIDERATIONS

Little is known about the type of materials which underlie the damsite, and it is difficult to determine a foundation suitability at this time. However, in general, if foundation preparation extends to either in-place basalt or siltstone of the Latah Formation, the bearing strength of these materials should be satisfactory. Undisturbed glacial outwash deposits of sand or gravel should also have sufficient strength to support the proposed dam, but would be highly permeable.

Colluvial slopewash, talus or blocky basalt "haystack" accumulations which mantle the abutments are so variable in physical characteristics that, until investigations are made, they should be considered unsuitable for dam foundations.

4. EMBANKMENT MATERIALS

In our opinion, there are sufficient suitable materials for the construction of the dam within the reservoir and nearby areas. The materials exposed at the ground surface appear to be relatively well-graded, silty sands and gravels, and are semipervious when compacted. These soils are generally shallow ($<$ 10 ft.) but appear to cover a wide area. Sands, gravels and talus could also probably be utilized in various portions of a zoned dam. Other than basalt talus and "haystacks" which are present in unknown quantities, there are also several basalt outcrops nearby which could be quarried to obtain suitable basalt rock for rip-rap or for a rock fill structure. Cost factors of obtaining construction materials would probably dictate the type of dam to be built.

5. EMBANKMENT SLOPES

Provided a positive cutoff can be established, it is our opinion that either a homogenous or zoned earthfill dam or a rockfill dam could be built with available materials. If upstream blanketing proves necessary, the earth dam may be the only practical alternative. Embankment slopes for an earthfill structure would probably be in the order of 2.5:1 upstream, and perhaps 2:1 downstream. These values may be used for preliminary analyses. An internally zoned rockfill dam would have slopes on the order of 1.5:1 on both upstream and downstream faces.

Preliminary Damsite Review
Spokane River Basin

BRUCE CANYON SITE (26/44-18)

1. GENERAL

The Bruce Canyon site is in a northwest trending reentrant, carved into a silt covered remnant basalt flow that has been separated from the Columbia Plateau flows by Spokane River erosion. Bruce Canyon and a similar reentrant, Pleasant Prairie Canyon, to the south, have cut into this upland plateau and divide it into two relatively flat areas known as Orchard Prairie (to the west) and Pleasant Prairie (to the east).

In general, the basalt cap rock appears to be thin (less than 75 ft.) and overlies hard silt (siltstone) of the Latah Formation. The Latah beds appear to pinch out south of the reservoir site, where well logs report basalt directly overlies granite.

Abutment slopes apparently begin below the basalt cap rock and appear to be mantled with basalt talus and "haystack" blocks mixed with reworked silt and colluvium from the upland areas. The depth of this mantle is unknown, but may extend to several tens of feet locally. Moderately deep deposits of alluvial and lacustrine sand and silt occur near the bottom of the canyon. In addition, a narrow strip of silty clay with a reported high water table appears to follow an intermittant stream course in the lower portions of the canyon bottom.

2. RESERVOIR PERMEABILITY

If the dam can be founded on the hard siltstone of the Latah Formation, reservoir seepage should be minimal. Siting on recent alluvial deposits or on unconsolidated talus/colluvium is not recommended. Seepage from the reservoir could find its way to the surface and flow into Deadman Creek or possibly find its way into the groundwater system beneath Peone Prairie. The groundwater system here is in highly irregular glacial lakebed deposits. Thick beds of "blue" clay and discontinuous lenses of fine sand characterize the groundwater basin, although buried sand or gravel beds could possibly channel groundwater westward to the more pervious sand and gravel groundwater basin of the Hillyard trough.

3. FOUNDATION CONSIDERATIONS

In our opinion, Latah siltstone beds underlie the unconsolidated mantle at the dam site and reservoir area, although depth is unknown. The Latah would form a satisfactory foundation for the dam if present at reasonable depth. Subsurface investigations would be necessary to establish the depth and character of the alluvial overburden, as the presence of clay beds similar to those to the north may make dam construction at this site impracticable.

4. EMBANKMENT MATERIALS

In our opinion, sufficient quantities of relatively impervious silt and/or clay could be obtained from reworked loess or glacial lake depsoits within 2 miles of the dam site (from unfarmed areas of Pleasant, Orchard and Peone Prairies). Colluvial and talus materials from abutment stripping may also be suitable for certain portions of the dam. Pervious sand and gravel is available within 5 miles of the site in the Mead area.

Rock, other than talus, may be available by quarrying the basalt cap rock where it outcrops above the reservoir. Best outcrops appear to be near the right abutment of the dam.

5. EMBANKMENT SLOPES

A silt/clay homogenous dam structure would require embankment slopes in the order of 3:1 on the upstream face and 2.5:1 on the downstream face.

A zoned rock fill dam (impervious core) would require slopes on the order of 1.5:1 both upstream and downstream.

Preliminary Damsite Review
Spokane River Basin

MOFFAT ROAD SITE (26/44-16)

1. GENERAL

The Moffat Road site is a northwest trending reentrant canyon which dissects a portion of a silt mantled remnant basalt plateau known as Pleasant Prairie. Basalt cap rock is at or near the surface at the upper elevations of the abutments. These upper slopes are mantled with silty talus and colluvium. Midslopes are characterized by a mantle containing silty glacial-fluvial gravels mixed with reworked loess (silt). Occasional large basalt blocks, "haystacks", are also found on the midslope sections. Lower slopes are mantled with silty, glacial lake sediments. A narrow strip of recent alluvial silt and clay follows the intermittent stream channel in the bottom of the canyon. It appears that Latah siltstone underlies the basalt cap rock and the unconsolidated materials mantling the abutments, and extends below the canyon bottom. Depths of the abutment mantles and the glacial lake and alluvial deposits in the canyon bottom are unknown.

2. RESERVOIR PERMEABILITY

In our opinion, most of the reservoir area is underlain by hard, relatively impervious siltstone of the Latah Formation, and seepage through these materials, in our opinion, would be minimal. This would be true also at the damsites if it proves practicable to remove the unconsolidated abutment mantle. Controlled seepage that did occur would probably find its way into the Peone Creek and Deadman Creek drainages or into the layered clay-sand lake deposits that underlie Peone Prairie. This is not considered a major groundwater aquifer, although the presence of an underground channel (we know of none at present) could direct seepage to the more important aquifer which underlies the Hillyard trough to the west.

3. FOUNDATION CONSIDERATIONS

If stripping to competent siltstone proves practicable, no major foundation problems are anticipated. The quantity of unsuitable materials which would have to be stripped from the dam abutments and valley bottom is unknown at present.

MOFFAT ROAD SITE (26/44-16) Cont'd.

4. EMBANKMENT MATERIALS

Embankment construction materials, available from nearby sources, appear to consist of silt/clay, reworked loess, or glacial lake materials from Pleasant or Peone Prairies. In addition, some quantities of weathered decomposed granite soil may be available from foothill slopes 3 to 4 miles east of the damsite. Pervious sands and gravels may be available within 7 to 10 miles of the damsite near Mead.

Suitable quantities of quality rock for rip-rap or rock fill structures could probably be obtained by quarrying nearby basalt outcrops on the plateau.

5. EMBANKMENT SLOPES

Embankment slopes required for a homogeneous earth dam should not be less than 3:1 on the upstream face and 2.5:1 on the downstream face.

A zoned rock fill structure with an impervious core would require slopes on the order of 1.5:1 on both upstream and downstream faces.

CANFIELD GULCH (26/45-28-29)

1. GENERAL

Canfield Gulch is a south trending canyon that is tributary to the Spokane River valley. This canyon and many similar ones on both the north and south sides of the Spokane valley are filled with Quaternary lake and/or kame deposits of fine to coarse sand. The mouths of these canyons were also filled with significant depths of glacial outwash and flood gravels. Metamorphic rock ridges at each side of the mouth of Canfield Gulch form the abutments for a dam at this site. The rock typically varies from highly jointed to massive. Condition of the rock at the abutments is unknown.

2. RESERVOIR PERMEABILITY

The materials which form the lower abutment slopes and dam base area at the Canfield Gulch site are, in our opinion, relatively clean, fine to coarse, sands or gravels. The reservoir is within a enclosed rock basin and, in our opinion, seepage should be minimal. However, significant depths of pervious materials are at the dam site and cutoff excavations to impervious materials could pose major construction problems.

Leakage from the reservoir or around and under the dam would flow rapidly into the Spokane Valley aquifer.

3. FOUNDATION CONSIDERATIONS

Glacial flood gravels, such as found at the mouth of Canfield Gulch, generally have sufficient strength to support loads in excess of those required for the proposed dam. However, the pervious nature of these foundation soils would probably require a deep cutoff or extensive upstream blanketing to maintain seepage beneath the dam at acceptable levels. Thus, sealing of the dam foundation would be a major construction cost at this site, in our opinion.

4. EMBANKMENT MATERIALS

Adequate supplies of sand and gravel appear to be available at the site for embankment construction. Rock could also be quarried nearby. Relatively

impervious soils may be obtained from shallow weathered rock deposits that overlie the adjacent mountain ridges. Recent and Quaternary alluvial deposits near the head of Canfield Gulch may also be a source for relatively impervious material.

5. EMBANKMENT SLOPES

A zoned dam embankment at the Canfield Gulch site, with pervious upstream and downstream shells and an impervious core would require embankment slopes in the order of 2.5:1 upstream and downstream. A homogeneous dam would require slopes in the order of 3:1 upstream and 2.5:1 downstream.

A zoned rock fill dam embankment would have slopes in the order of 1.5:1 on both upstream and downstream faces.

Preliminary Damsite Review
Spokane River Basin

GREEN BLUFF SITE (27/44-30)

1. GENERAL

The Green Bluff site is in a southwest trending reentrant canyon that dissects a remnant basalt capped plateau. The plateau (Green Bluff) is covered with a mantle of reworked gravelly loessial silt we judge to be in the order of 20 ft. thick. Basalt cap rock, generally less than 30 ft. thick and thinning to the north and east, underlies the silt. In our opinion, basalt lies directly on granite north of the reservoir area, but overlies siltstone of the Latah Formation in most of the reservoir area and at the dam site. The dam abutments appear to be primarily mantled with basalt and silt colluvium which contains areas of talus and "haystacks". Thickness of these unconsolidated materials is unknown, but probably extends to several tens of feet. Recent alluvial deposits of silt and clay appear to be present in the bottom of the canyon at the damsite. Depth of the alluvium is unknown, but probably does not exceed a few feet. Clay and sand glacial lake sediments and/or granite probably underlie the alluvial sediments.

2. RESERVOIR PERMEABILITY

Seepage from the reservoir basin is expected to be minimal due to the siltstone or rock that, in our opinion, underlies most of the basin. Seepage through the unconsolidated materials at the damsite could be significant unless cutoff trenches to underlying relatively impervious materials are constructed. Seepage from the reservoir or around or beneath the dam, in our opinion, would either surface into a tributary to Deadman Creek or infiltrate the glacial lake sediments that fill the valley of Peone Prairie, south of Green Bluff. The glacial lake sediments are interlayered clays and sands with unknown aquifer characteristics. The Peone Prairie aquifer is not considered a major source of groundwater due to the discontinuity of pervious beds.

3. FOUNDATION CONSIDERATIONS

The depth and characteristics of alluvium and underlying glacial lake sediments, if present, will probably determine site feasibility at this

location. Significant depths of compressible and/or permeable soils may make dam construction impracticable. The presence of siltstone at shallow depth, on the otherhand, would provide a competent impervious foundation for the dam structure.

4. EMBANKMENT MATERIALS

Relatively impervious, reworked, gravelly loessial silt from upland deposits within the reservoir area could probably be used in the construction of a homogeneous dam embankment. It is our opinion that sufficient quantities of suitable materials are located near the site. Rock materials would be quarried from basalt outcrop quarries near the abutments or from granite outcrops which occur within 1 mile of each abutment. Thin overburden deposits of weathered granite soils which would be stripped before quarry operations could begin could probably be utilized within the dam embankment.

Pervious sand or gravel deposits occur within 5 miles of the site within glacial outwash deposits of the Hillyard trough.

5. EMBANKMENT SLOPES

An homogeneous earthfill dam at the Green Bluff site would require embankment slopes in the order of 3:1 on the upstream slope and 2.5:1 on the downstream slope.

A zoned rock fill structure would require slopes on the order of 1.5:1 on both upstream and downstream faces.

APPENDIX II

NARRATIVE EVALUATION

ALTERNATIVE PLAN: "A"

PLAN ELEMENTS: (C+NS)-sw; SV-sw

DESCRIPTION: City and North Spokane combined to surface water disposal; Spokane Valley separately to surface water disposal.

1. COST-EFFECTIVENESS EVALUATION

a. Capitalized Cost Basis

Planning period facilities cost expressed as present worth, millions of dollars.

1)	Total, including capital and O and M	42.0
2)	Capital costs only, including land	14.7
3)	Operation and maintenance costs only	27.3

b. Annualized Cost Basis

Planning period facilities cost expressed as equivalent equal annual cost, dollars per year.

1)	Total, including capital and O and M	4.0
2)	Capital costs only, including land	1.4
3)	Operation and maintenance costs only	2.6

c. Capitalized cost of this project is 0 million dollars more than the most cost effective project.

2. DIRECT ECONOMIC CONCERNS

a. What relative impact will the capital funding of this plan alternative have on the total supply and availability of capital funds to meet other community needs?

Has lowest capital fund requirements.

b. What will be the relative impact of operation and maintenance costs of this plan alternative on utility rates and/or tax rates?

Ranks 5th from lowest requirement for mean annual operation and maintenance funds. There is actually little significant difference in rank between Plans A, B, C, D and H with ranks 4 through 8.

c. What relative impact will any displacements caused by this plan alternative have on employment and community real income?

Ranks with Plans D and H as having lowest impact on employment and community income since there are no significant displacements in this plan.

d. What relative impact will any displacements caused by this plan alternative have on tax income of the community?

Lands with approximate market value of $26,000 are taken from the tax rolls for implementation. Ranks 2nd from lowest in minimizing loss of tax revenue.

3. INDIRECT ECONOMIC CONCERNS

a. What relative impact will this plan alternative have on the general desirability of this area as a place to operate a business which will be reflected in the rate of economic development of the area? What relative impact will this plan alternative have on the general level of economic activity of the area which will be reflected in property values and tax income of the community?

Plans A, B, C, D, G and H are judged to have comparable attractiveness to business and increased economic development. They offer comparable community attractiveness benefits and have comparable effect on the general level of taxes and utility rates. These plans are ranked together as having the most favorable impact on economic development.

4. TRANSIENT ECONOMIC CONCERNS

a. What will be the relative impact of project construction on local employment during the construction period based on this plan alternative?

Local potential for increased employment during construction ranks 7th due to relatively small amounts of construction required, particularly in conveyance facilities.

b. What relative impact will the construction of this plan alternative have on local manufacturing and materials supply business?

Potential for sale of local materials and products rank 7th due to relatively small amounts of construction required, particularly in conveyance facilities.

c. What relative impact will the construction of this plan alternative have on temporary disruptions of circulation and/or business activity that will result in reduced employment or other economic loss?

Ranks 2nd from lowest in disruption potential with approximately

2 miles of conveyance in moderately built up area and 4 miles of conveyance along traveled ways outside built up areas.

5. SOCIAL CONCERNS FOR THE COMMUNITY

a. What relative impact will this plan alternative have on the health, welfare and safety of the community?

All candidate plans are formulated to have a strong positive impact on health, welfare and safety. The screening of potential negative impacts indicates that this plan has exposures associated with surface water and raw sewage pumping and has no exposures associated with groundwater and irrigation. This plan is ranked 2nd in lowest risk along with Plan B.

b. Will the implementation of this plan alternative cause disruptions of existing community living patterns such as location, quality and character of residential communities, locations and kinds of employment and general cultural activities?

This plan, along with Plans C and H will have negligible disruptive impact of the community.

c. What relative impact will this plan alternative have on the recreation patterns of the community?

Provides high absolute improvement of surface water above present conditions but ranks below plans which completely eliminate surface water disposal. Does not divert any land areas to disposal use. Relative rank is next to lowest for potential for improved recreational opportunities.

d. What relative impact will this plan alternative have on land use and land use planning?

All plans, except the no action plan, by solving area-wide wastewater management problems remove one of the constraints to development thereby making land use planning an essential for controlled development. This plan does not preempt any extensive lands and thus ranks lowest in physical constraints on land use along with Plans C and H.

6. SOCIAL CONCERNS FOR THE INDIVIDUAL

a. Will the implementation of this plan alternative cause dislocations which will effect the place of residence, employment, mobility and general cultural activity of a significant number of individuals?

This plan, along with Plans C and H will cause negligible disruption of individuals.

b. To what extent will the implementation of this plan impact indi-

vidual life style?

All plans have negligible impact on general life style.

7. CONCERN FOR GROUNDWATER QUALITY

a. What is the relative potential of this plan for impact on groundwater quality?

The surface water disposal at the City STP for the NS and C service areas has almost zero potential for groundwater impact since, on the average, the groundwater exchange is into the river downstream from the City STP except in the immediate vicinity of Nine Mile Dam. The surface water disposal for SV service area at approximate RM 79 is selected to be downstream from the main City wells at Parkwater but is upstream from a reach that, on the average, discharges from the river into groundwater. Primarily because of the effluent location at RM 79, this plan is ranked to have a higher potential impact on an important groundwater body than Plan C which has a discharge only at the City STP. Due to the greater importance of the Spokane Valley aquifer, the significance of this potential impact is ranked higher than those due to possible percolation from irrigation in Plans E, F and G.

Plan H has a comparable potential and is ranked with Plan A as having the 4th lowest impact.

8. CONCERN FOR SURFACE WATER QUALITY

a. What is the relative potential of this plan for impact on surface water quality?

The two surface water disposals to 1983 standards proposed in this plan should meet without reservation all requirements for Class A in the receiving waters. The presence of a discharge at RM 79 and at the City STP means that the reach from RM 79 downriver into Long Lake is less than natural conditions at all times and in the case of a malfunction could fall to less than Class A standards. Considering these exposures, the relative impact on surface water quality for all concerns is ranked 2nd highest along with Plan B which has the same two discharge sites.

9. CONCERNS FOR LAND USE

What are the land use requirements for this candidate plan?

This plan has no significant impacts on land use. Except for the requirement for a treatment plant site, about 12 acres, in the vicinity of Felts Field, this plan will not take any land not already dedicated to wastewater management. Plan is ranked as

follows for the three areas of concern.

a. What relative impact will this plan have on the quantity or quality of land available for wildlife habitat, natural vegetation and open space?

Ranks 2nd in preservation.

b. What relative impact will this plan have on the aesthetic quality of the landscape?

Ranks 2nd in preservation.

c. What constraints will this plan place on other beneficial uses of land?

Ranks 2nd in minimizing constraints.

10. CONCERNS FOR AIR QUALITY

a. What effect will the implementation of this plan alternative have on the public health aspects of air quality?

No negative impact. Ranks with Plans C, D and H which also have no negative impact on health aspects of air quality.

b. What effect will the implementation of this plan alternative have on the aesthetic aspects of air quality?

Small potential for negative impact from treatment plants. Having two plants rather than one like Plan C, ranks 2nd lowest in odor potential.

11. CONCERNS FOR ENERGY AND RESOURCES

a. How does this project compare with other plan alternatives with respect to the need for:

1) Electrical energy input?

Has lowest energy requirement (407.2 x 10^6 kwh) because there is only one conveyance lift for North Spokane service area. The larger flows for City and Spokane Valley are not involved in service conveyance or disposal pumping lifts.

2) Thermal energy input?

Negligible for all plans.

b. How does this plan alternative compare with other alternatives with respect to need for consumption of chemicals or other consumable

resources which may be in short supply?

Ranks 4th with Plans C and H which have identical alum usages required for phosphorus removal to surface waters for all three service areas.

c. What positive aspects does this plan alternative have with respect to salvage of energy or reusable chemical resources?

The entire flow of all three service areas is discharged to the Spokane River and become available for power production in WWP dams and downriver Columbia installations. There is no recovery of nutrient chemicals. The direct hydro energy recovery potential of this plan and Plans B, C, and H is approximately equal to the energy equivalent of recovered nitrogen fertilizer of Plan F giving Plans A, B, C, F and H equal rank. (125 to 135 x 10^6 kwh.)

d. How does this plan compare with other plan alternatives in net energy requirements after considering credits for resource recovery potential.

Ranks lowest in net energy requirement due to lowest basic input requirement and recovery potential equal to the highest ranked recovery. (272 x 10^6 kwh net.)

12. PERFORMANCE EVALUATION

a. How does this plan alternative compare with others in technical performance toward releasing to the environment the highest quality renovated wastewater?

Plan A has two surface water discharges from activated sludge secondary treatment plants and is rated 7th in renovated quality.

b. How does this plan alternative compare with others in reliability of technical performance?

Lack of storage between treatment and ultimate discharge to the environment causes this plan to be ranked 7th in reliability.

13. FLEXIBILITY

a. How does this plan alternative rate for its flexibility in being adaptable to unanticipated changes in rate and location of growth?

The primary unfavorable element is the conveyance from NS to the City STP. The City STP site has capacity for expansion well beyond the forecast needs of NS and C combined. The only conveyance for SV is the 2.8 mile effluent sewer, the minimum

for any Plan. Expansion at SV treatment site should be feasible. Plan A is ranked 3rd from most flexible.

b. How does this plan alternative rate for its flexibility in adapting to possible changes in water quality criteria and goals?

For changes in surface water criteria, this plan is faced with making changes at two plants. Alternatives open are going to higher level treatment, to percolation or irrigation. Cost effectiveness analysis indicates that for extreme requirements, land percolation would be least costly, that is going to Plan D. This plan is ranked 6th.

c. How does this plan alternative rate for flexibility in being able to utilize future changes in technology of wastewater treatment?

The plan, along with Plan D, both of which have two concentrated site plants, is ranked 3rd for flexibility.

NARRATIVE EVALUATION

ALTERNATIVE PLAN: "B"

PLAN ELEMENTS: C-sw; NS-li; SV-sw

DESCRIPTION: City separately to surface water; North Spokane separately to land irrigation; Spokane Valley separately to surface water.

1. COST-EFFECTIVENESS EVALUATION

a. Capitalized Cost Basis

Planning period facilities cost expressed as present worth, millions of dollars.

1)	Total, including capital and O and M	51.3
2)	Capital costs only, including land	24.5
3)	Operation and maintenance costs only	26.8

b. Annualized Cost Basis

Planning period facilities cost expressed as equivalent equal annual cost, dollars per year.

1)	Total, including capital and O and M	4.8
2)	Capital costs only, including land	2.3
3)	Operation and maintenance costs only	2.5

c. Capitalized cost of this project is 9.3 million dollars more than the most cost effective project.

2. DIRECT ECONOMIC CONCERNS

a. What relative impact will the capital funding of this plan alternative have on the total supply and availability of capital funds to meet other community needs?

Ranks 3rd from lowest in capital fund requirements.

b. What will be the relative impact of operation and maintenance costs of this plan alternative on utility rates and/or tax rates?

Ranks 4th from lowest requirement for mean annual operating funds. There is actually little significant difference in rank

between Plans A, B, C, D and H which include ranks 4 through 8.

c. What relative impact will any displacements caused by this plan alternative have on employment and community real income?

Ranks 3rd from lowest three plans in displacement potential due to requirements for in excess of 2000 acres in Peone Prairie for lagoons, storage and irrigation.

d. What relative impact will any displacements caused by this plan alternative have on tax income of the community?

Lands with approximate market value $1,300,000 are taken from the tax rolls for implementation. Ranks 5th from lowest in minimizing loss of tax revenue.

3. INDIRECT ECONOMIC CONCERNS

a. What relative impact will this plan alternative have on the general desirability of this area as a place to operate a business which will be reflected in the rate of economic development of the area? What relative impact will this plan alternative have on the general level of economic activity of the area which will be reflected in property values and tax income of the community?

Plans A, B, C, D, G and H are judged to have comparable attractiveness to business and increased economic development. They offer comparable community attractiveness benefits and have comparable effect on the general level of taxes and utility rates. These plans are ranked together as having the most favorable impact on economic development.

4. TRANSIENT ECONOMIC CONCERNS

a. What will be the relative impact of project construction on local employment during the construction period based on this plan alternative?

Local potential for increased employment during construction ranks 5th due to relatively low expenditures for both treatment, conveyance and earthwork facilities.

b. What impact will the construction of this plan alternative have on local manufacturing and materials supply business?

Potential for sale of local materials and products ranks 6th due to relatively low expenditures for treatment and conveyance facilities.

c. What relative impact will the construction of this plan alternative have on temporary disruptions of circulation and/or business activity that will result in reduced employment or other economic loss?

Ranks 3rd from lowest disruption potential with approximately 2 miles of conveyance construction in moderately built up areas and approximately 7 miles parallel to traveled ways in lightly built-up and rural areas.

5. SOCIAL CONCERNS FOR THE COMMUNITY

a. What relative impact will the implementation of this plan alternative have on the health, welfare and safety of the community?

All candidate plans are formulated to have a strong positive impact on health, welfare and safety. The screening of potential negative impacts indicates that this plan has exposures associated with surface water, irrigation and raw sewage pumping and has no exposures associated with groundwater. This plan is ranked second lowest in risk along with Plan A.

b. Will the implementation of this plan alternative cause disruptions of existing community living patterns such as location, quality and character of residential communities, locations and kinds of employment and general cultural activities?

There will be community disruption caused by preempting approximately 2400 acres for lagoons, storage and irrigation. This plan is ranked 3rd from lowest in disruptive potential.

.. What relative impact will this plan alternative have on the recreation patterns of the community?

Provides high absolute improvement of surface waters above present conditions but ranks below plans which completely eliminate surface disposal. Ranks with Plans A and H for surface water impact. Diversion of land to wastewater use for NS irrigation is a negative impact on recreational opportunity. Relative rank is 6th from highest potential for improved recreation opportunities.

d. What impact will the implementation of this plan alternative have on land use and land use planning?

All plans, except the no action plan, by solving area-wide wastewater management problems, remove one of the constraints to development thereby making land use planning an essential for controlled development. This plan physically constrains land use and land use planning in the 2400 acre area taken for wastewater management. Plan is ranked 3rd from lowest in physical impact on land use.

6. SOCIAL CONCERNS FOR THE INDIVIDUAL

a. Will the implementation of this plan alternative cause dislocations which will effect the place of residence, employment, mobility and

general cultural activity of a significant number of individuals?

This plan has dislocation impact in the 2400 acres taken for wastewater management. Rank 3rd from lowest in dislocation impacts.

b. To what extent will the implementation of this plan impact individual life style?

All plans have negligible impact on general life style.

7. CONCERN FOR GROUNDWATER QUALITY

a. What is the relative potential of this plan for impact on groundwater quality?

Plan B has surface water discharges at the City STP and at RM 79 as do Plans A and H. Therefore, the potential impact on groundwater due to these two discharges alone is the same as A and H. In addition, Plan B has an irrigation disposal to the surface of Peone Prairie from which there is a potential percolation to groundwater. The additional exposure due to irrigation percolation is evaluated as relatively small but significant enough to rank Plan B with greater impact potential than Plans A and H. Therefore, Plan B is ranked 5th lowest in potential groundwater impact.

8. CONCERN FOR SURFACE WATER QUALITY

a. What is the relative potential of this plan for impact on surface water quality?

The two surface water disposal to 1983 standards proposed in this plan should meet without reservation all requirements for Class A in the receiving waters. The presence of a discharge at RM 79 and at the City STP means that the reach from RM 79 downriver into Long Lake is less than natural conditions at all times and in the case of a malfunction could fall to less than Class A standards. Considering these exposures, the relative impact on surface water quality for all concerns is ranked 2nd highest along with Plan A which has the same two discharge sites. The lesser flow to the City STP caused by NS area diversion to irrigation is judged to be insignificant in comparing Plans A and B.

9. CONCERNS FOR LAND USE

What are the land use requirements of this candidate plan?

This plan requires approximately 2400 acres of rural land in Peone Prairie area for lagoons, storage and irrigation and approximately 12 acres near Felts Field for a treatment site. Much of the rural

area taken is dry farmed land at present but some of the land in the storage site is in natural woods. Plan is ranked as follows for the three areas of concern:

a. What relative impact will this plan have on the quantity or quality of land available for wildlife habitat, natural vegetation and open space?

Ranks 4th in preservation.

b. What relative impact will this plan have on the aesthetic quality of the landscape?

Ranks 4th in preservation.

c. What constraints will this plan place on other beneficial uses of land?

Ranks 4th in minimizing constraints.

10. CONCERNS FOR AIR QUALITY

a. What relative effect will the implementation of this plan alternative have on the public health aspects of air quality?

There is potential for aerosol contamination of air from irrigation of approximately 2000 acres. Ranks 2nd lowest in exposure potential to the no impacc plans.

b. What relative effect will the implementation of this plan alternative have on the aesthetic aspects of air quality?

There is a small potential for odor problems in connection with irrigation from septicity in distribution mains and a small potential from storage reservoirs due to septic conditions from algae. Ranks 4th lowest in exposure potential.

11. CONCERNS FOR ENERGY AND RESOURCES

a. How does this project compare with other plan alternatives with respect to the need for:

1) Electrical energy input?

Has second lowest energy use (437.7 x 10^6 kwh). Has higher use than Plan A because separate treatment for NS requires more than when combined with City plus greater conveyance pumping to irrigation.

2) Thermal energy input?

Negligible for all plans.

b. How does this plan alternative compare with other alternatives with respect to need for consumption of chemicals or other consumable resources which may be in short supply?

Ranks 3, requiring slightly less alum for phosphate removal since it is not required for the North Spokane portion disposal to irrigation.

c. What positive aspects does this plan alternative have with respect to salvage of energy or reusable chemical resources?

The flow of the two largest service areas is discharged to the Spokane River and becomes available for hydro power production in WWP plants. There is nutrient recovery potential for North Spokane service area flows directed to irrigation. The sum of the hydro energy potential and equivalent energy as nutrient recovery is approximately equal to the hydro power potential of Plans A, C and H and the nutrient equivalent of Plan F. Thus Plans A, B, C, F and H are ranked together (125 - 135 x 10^6 kwh).

d. How does this plan compare with other plan alternatives in net energy requirements after considering credits for resource recovery potential?

Ranks 2nd along with Plan H due to having second lowest energy input needs and having recovery credit ranked with highest (307 x 10^6 kwh net).

12. PERFORMANCE EVALUATION

a. How does this plan alternative compare with others in technical performance toward releasing to the environment the highest quality renovated wastewater?

The NS service area has irrigation disposal but the City and SV service areas are separate surface water disposals from activated sludge secondary plants. Plan B is ranked 6th in overall performance.

b. How does this plan alternative compare with others in reliability of technical performance?

The combination of lagoon treatment and irrigation disposal provide high reliability for the NS service area but the City and SV service areas discharge directly from activated sludge treatment to surface waters. Plan B is ranked 6th in reliability.

13. FLEXIBILITY

a. How does this plan alternative rate for its flexibility in being

adaptable to unanticipated changes in rate and location of growth?

Three separate treatment facilities for the three service areas favor flexibility. The City plant has extra capacity without construction and requires no conveyance. The SV site is favorable for expansion and has the minimum conveyance for this service area. The only inflexible elements are the NS conveyance to the lagoon treatment site and the storage reservoir. The lagoon system lends itself to stage expansion as does the irrigation system. This plan is ranked 2nd most flexible after Plan H.

b. How does this plan alternative rate for its flexibility in adapting to possible changes in water quality criteria and goals?

Two separate plants have surface water disposal and would face the same alternatives as Plan A. Since NS service area is already proposed to irrigation under this plan, it is likely that irrigation would be more favored than percolation as an alternative for SV service area. The problems confronting this plan are judged equal to those facing Plans A and D, ranked 3rd.

c. How does this plan alternative rate for flexibility in being able to utilize future changes in technology of wastewater treatment?

This plan with two concentrated site plants and one lagoon treatment facility is ranked 4th in flexibility.

NARRATIVE EVALUATION

ALTERNATIVE PLAN: "C"

PLAN ELEMENTS: (C+NS+SV)sw

DESCRIPTION: City, North Spokane and Spokane Valley combined to surface water disposal.

1. COST-EFFECTIVENESS EVALUATION

   a. Capitalized Cost Basis

      Planning period facilities cost expressed as present worth, millions of dollars

1)	Total, including capital and O and M	53.8
2)	Capital costs only, including land	26.5
3)	Operation and maintenance costs only	27.3

   b. Annualized Cost Basis

      Planning period facilities cost expressed as equivalent equal annual cost, dollars per year.

1)	Total, including capital and O and M	5.1
2)	Capital costs only, including land	2.5
3)	Operation and maintenance costs only	2.6

   c. Capitalized cost of this project is 11.8 million dollars more than the most cost effective project.

2. DIRECT ECONOMIC CONCERNS

   a. What relative impact will the capital funding of this plan alternative have on the total supply and availability of capital funds to meet other community needs.

      Ranks 4th from lowest in capital fund requirements.

   b. What will be the relative impact of operation and maintenance costs of this plan alternative on utility rates and/or tax rates?

      Ranks 6th from lowest requirement for mean annual operating and maintenance funds. There is actually little difference in rank between Plans A, B, C, D and H which include ranks 4 through 8.

c. What relative impact will any displacements caused by this plan alternative have on employment and community real income?

Ranks with Plans A and H as having lowest impact on employment and community income since there are no significant displacements in this plan.

d. What relative impact will any displacements caused by this plan alternative have on tax income of the community?

Land with approximate market value of $3,500 are taken from the tax rolls for implementation. Ranks 1st in minimizing loss of tax revenue.

3. INDIRECT ECONOMIC CONCERNS

a. What relative impact will this plan alternative have on the general desirability of this area as a place to operate a business which will be reflected in the rate of economic development of the area? What relative impact will this plan alternative have on the general level of economic activity of the area which will be reflected in property values and tax income of the community?

Plans A, B, C, D, G and H are judged to have comparable attractiveness to business and increased economic development. They offer comparable community attractiveness benefits and have comparable effect on the general level of taxes and utility rates. These plans are ranked together as having the most favorable impact on economic development.

4. TRANSIENT ECONOMIC CONCERNS

a. What will be the relative impact of project construction on local employment during the construction period based on this plan alternative?

Local potential for increased employment during construction ranks 6th having relatively large treatment plant expenditures but only moderate conveyance facilities expenditures.

b. What relative impact will the construction of this plan alternative have on local manufacturing and materials supply business?

Potential for increased sales of local materials and products during construction ranks 5th due to combination of relatively large treatment expenditures with moderate conveyance expenditures.

c. What relative impact will the construction of this plan alternative have on temporary disruptions of circulation and/or business activity that will result in reduced employment or other economic loss?

This plan has the highest potential for disruption due to the construction of Spokane Valley service conveyance for approximately 9 miles through built up areas and particularly along important circulation streets in the City of Spokane.

5. SOCIAL CONCERNS FOR THE COMMUNITY

a. What relative impact will this plan alternative have on the health, welfare and safety of the community?

All candidate plans are formulated to have a strong positive impact on health, welfare and safety. The screening of potential negative impacts indicates that this plan has exposures associated with surface water, and raw sewage pumping and has no exposures associated with groundwater and irrigation. This plan is ranked 3rd lowest in risk along with Plans E, G, and H.

b. Will the implementation of this plan alternative cause disruptions of existing community living patterns such as location, quality and character of residential communities, locations and kinds of employment and general cultural activities?

This plan, along with Plans A and H will have negligible long term disruptive impact on the community.

c. What relative impact will this plan alternative have on the recreation patterns of the community?

Provides high absolute improvement of surface waters above present condition. Ranks below those that completely eliminate surface water disposal but above Plans A, B and H in that there is no surface water disposal upstream from the City STP. Diverts no land. Ranks 5th from highest potential for improved recreation opportunities.

d. What relative impact will this plan alternative have on land use and land use planning?

All plans, except the no action plan, by solving area wide wastewater management problems, remove one of the constraints to development thereby making land use planning an essential for controlled development. This plan does not preempt any extensive lands and thus ranks lowest in physical constraints on land use along with Plans A and H.

6. SOCIAL CONCERNS FOR THE INDIVIDUAL

a. Will the implementation of this plan alternative cause dislocations which will effect the place of residence, employment, mobility and general cultural activity of a significant number of individuals?

This plan, along with Plans A and H will cause negligible disruption of individuals.

b. To what extent will the implementation of this plan impact individual life style?

All plans have negligible impact on general life style.

7. CONCERN FOR GROUNDWATER QUALITY

a. What is the relative potential of this plan for impact on groundwater quality?

Plan C is all surface water disposal at one location, the City STP. Since the potential for river exchange to groundwater is minimal downstream from the City STP this plan has low potential for groundwater impact. This plan is ranked as having the lowest potential groundwater quality impact.

8. CONCERN FOR SURFACE WATER QUALITY

a. What is the relative potential of this plan for impact on surface water quality?

The single surface water disposal to 1983 standards proposed in this plan should meet, without reservation, all requirements for Class A in the receiving waters. The only discharge being at the City STP means that exposure to less than natural conditions and vulnerability to a malfunction is restricted to downstream from that point. This exposure ranks Plan C at 5th from lowest in potential impact on surface water quality.

9. CONCERNS FOR LAND USE

What are the land use requirements of this candidate plan?

This plan requires no land not already dedicated to wastewater management use other than pump station sites. This plan is ranked highest in preservation of land for habitat and aesthetics and lowest in interference with other uses.

a. What relative impact will this plan have on the quantity or quality of land available for wildlife habitat, natural vegetation and open space?

Ranks 1st in preservation.

b. What relative impact will this plan have on the aesthetic quality of the landscape?

Ranks 1st in preservation.

c. What constraints will this plan place on other beneficial uses of land?

Ranks 1st in minimizing constraints.

10. CONCERNS FOR AIR QUALITY

a. What relative effect will the implementation of this plan alternative have on the public health aspects of air quality?

No negative impact. Ranks with Plans A, D and H which also have no negative impact on health aspects of air quality.

b. What relative effect will the implementation of this plan alternative have on the aesthetic aspects of air quality?

Small potential for negative impact from the treatment plant itself. Ranks lowest in potential odor problems since there is only one treatment plant and no potential from irrigation, storage or percolation.

11. CONCERNS FOR ENERGY AND RESOURCES

a. How does this project compare with other plan alternatives with respect to the need for:

1) Electrical energy input?

Has 4th lowest energy requiremen (488.7×10^6 kwh) because the service conveyance pumping for Spokane Valley more than offsets the advantages to all treatment combined to one facility.

2) Thermal energy input?

Negligible for all plans.

b. How does this plan alternative compare with other alternatives with respect to need for consumption of chemicals or other consumable resources which may be in short supply?

Ranks 4th with Plans A, and H which have identical alum usages required for phosphorus removal to surface water disposal for all service areas.

c. What positive aspects does this plan alternative have with respect to salvage of energy or reusable chemical resources?

The entire flow of all three service areas is discharged to the Spokane River and becomes available for power production in WWP dams and downriver Columbia installations. There is no recovery of nutrient chemicals. The direct hydro energy

recovery potential of this plan and Plans A, B, and H is approximately equal to the energy equivalent of recovered nitrogen fertilizer of Plan F giving Plans A, B, C, F and H equal rank. (125 to 135 x 10^6 kwh.)

d. How does this plan compare with other plan alternatives in net energy requirements after considering credits for resource recovery potential?

Ranks 3rd lowest in net energy requirement due to having 4th lowest basic input requirement and recovery potential ranked with the highest. (354 x 10^6 kwh net.)

12. PERFORMANCE EVALUATION

a. How does this plan alternative compare with others in technical performance toward releasing to the environment the highest quality renovated wastewater?

One large single plant favors quality performance over smaller plants but renovative quality from secondary treatment alone must be ranked below other plans with land application polishing. Plan is ranked 5th in quality.

b. How does this plan alternative compare with others in reliability of technical performance?

One large plant also favors reliability over two or three small plants but direct discharge to environment without storage to buffer malfunction disfavors reliability. Plan is ranked 5th in reliability.

13. FLEXIBILITY

a. How does this plan alternative rate for its flexibility in being adaptable to unanticipated changes in rate and location of growth?

This plan contains three unfavorable elements. The least difficult is the NS to City STP conveyance, in common with Plans A, D, E and F. The next most critical is that the forecast flows for the three service areas approaches the capacity of the City STP site. Any expansion of flow beyond 60 mgd would be extremely costly at the existing site or would require a supplementary separate site. The most critical item is the SV conveyance through the City of Spokane. This construction would be expensive and disruptive in the first place--to come back later with a parallel line to increase capacity would be even more so. For all these reasons, this plan is ranked least flexible.

b. How does this plan alternative rate for its flexibility in adapting to possible changes in water quality criteria and goals?

One treatment facility favors the ability to make all changes at one place. The lack of space for expansion at the City STP site, however, detracts from this favorable situation. The off-site percolation alternative is available. The net ranking of this plan is 5th from most favorable.

c. How does this plan alternative rate for flexibility in being able to utilize future changes in technology of wastewater treatment?

This plan with only one concentrated site plant is ranked 5th in flexibility due to the limited space at the existing City STP site which flows from all service areas are to be processed.

NARRATIVE EVALUATION

ALTERNATIVE PLAN: "D"

PLAN ELEMENTS: (C+NS)-sw/lp; SV-sw/lp

DESCRIPTION: City and North Spokane combined to surface water disposal to 1990 then to land percolation; Spokane Valley separately to surface water disposal to 1990 then to land percolation.

1. COST-EFFECTIVENESS EVALUATION

a. Capitalized Cost Basis

Planning period facilities cost expressed as present worth, millions of dollars.

1) Total, including capital and O and M	58.0
2) Capital costs only, including land	29.3
3) Operation and maintenance costs only	28.7

b. Annualized Cost Basis

Planning period facilities cost expressed as equivalent equal annual cost, dollars per year.

1) Total, including capital and O and M	5.5
2) Capital costs only, including land	2.8
3) Operation and maintenance costs only	2.7

c. Capitalized cost of this project is 16.0 million dollars more than the most cost effective project.

2. DIRECT ECONOMIC CONCERNS

a. What relative impact will the capital funding of this plan alternative have on the total supply and availability of capital funds to meet other community needs?

Ranks 5th from lowest in capital fund requirements.

b. What will be the relative impact of operation and maintenance costs of this plan alternative on utility rates and/or tax rates?

Ranks 7th from lowest in requirements for mean annual operation and maintenance funds. There is actually little significant difference in rank between plans A, B, C, D and H which include

ranks 4 through 8.

c. What relative impact will any displacements caused by this plan alternative have on employment and community real income?

Ranks 2nd from lowest three plans in displacement potential. There is a very small displacement potential for the 144 acre site required near Mead. The 528 acre site near Long Lake is essentially unoccupied at present.

d. What relative impact will any displacements caused by this plan alternative have on tax income of the community?

Lands with estimated market value of $1,200,000 are taken from the tax rolls. Plan ranks 4th in minimizing loss of tax revenue.

3. INDIRECT ECONOMIC CONCERNS

a. What relative impact will this plan alternative have on the general desirability of this area as a place to operate a business which will be reflected in the rate of economic development of the area? What relative impact will this plan alternative have on the general level of economic activity of the area which will be reflected in property values and tax income of the community?

Plans A, B, C, D, G and H are judged to have comparable attractiveness to business and increased economic development. They offer comparable community attractiveness benefits and have comparable effect on the general level of taxes and utility rates. These plans are ranked together as having the most favorable impact on economic development.

4. TRANSIENT ECONOMIC CONCERNS

a. What will be the relative impact of project construction on local employment during the construction period based on this plan alternative?

Local potential for increased employment during construction ranks 4th due to moderate levels of expenditure in treatment and conveyance areas.

b. What relative impact will the construction of this plan alternative have on local manufacturing and materials supply business?

Potential for increased sales of local materials and products during construction ranks 4th due to moderate levels of expenditure for conveyance facilities.

c. What relative impact will the construction of this plan alternative have on temporary disruptions of circulation and/or business

activity that will result in reduced employment or other economic loss?

This plan along with Plans E, F and G ranks 4th from lowest in disruption potential. All have approximately 7 miles of disposal conveyance for Spokane Valley through moderately built-up area and from 4 to 7 miles of service conveyance parallel to traveled roads for North Spokane. There are differing amounts of rural road conveyance for Plans D, E, F and G which are judged to not significantly affect ranking.

5. SOCIAL CONCERNS FOR THE COMMUNITY

a. What relative impact will this plan alternative have on the health, welfare and safety of the community?

All candidate plans are formulated to have a strong positive impact on health, welfare and safety. The screening of potential negative impacts indicates that this plan has exposures associated with surface water up to 1990 and with groundwater from 1990 on. There is a raw sewage pumping exposure for North Spokane only. There are no exposures associated with irrigation. This plan is ranked lowest in risk along with Plan F.

b. Will the implementation of this plan alternative cause disruptions of existing community living patterns such as location, quality and character of residential communities, locations and kinds of employment and general cultural activities?

There will be a minor dislocation only at the site for percolation in the vicinity of Mead. Plan ranks 2nd in minimizing disruptions.

c. What relative impact will this plan alternative have on the recreation patterns of the community?

From 1980 to 1990, surface water disposal to 1983 standards provides greatly improved recreation availability of the Spokane River and Long Lake, but not without some reservation. After 1990 there would be complete elimination of surface water discharge which would remove all reservation. There are some land diversions to wastewater management that could negatively impact recreation opportunities, particularly the attractive area on Long Lake taken for percolation. Plan ranks 3rd from highest for improvement of recreational opportunities.

d. What relative impact will this plan alternative have on land use and land use planning?

The required sites for percolation will eliminate potential residential use at the Downriver site and industrial use at the Mead site. Improvement of the recreation potential on Long

Lake will increase pressures for development in that area and require planning controls. Plan ranks 2nd in minimizing constraints to land use and planning after Plans A, C and H which have essentially no constraints.

6. SOCIAL CONCERNS FOR THE INDIVIDUAL

a. Will the implementation of this plan alternative cause dislocations which will effect the place of residence, employment, mobility and general cultural activity of a significant number of individuals?

The lands taken for wastewater management have relatively few persons at this time so that the potential for individual dislocations is small, second only to Plans A, C and H.

b. To what extent will the implementation of this plan impact individual life style?

All plans have negligible impact on general life style.

7. CONCERN FOR GROUNDWATER QUALITY

a. What is the relative potential of this plan for impact on groundwater quality?

Plan D is identical with Plan A to 1990, that is, with surface water discharges at the City STP and RM 79. Therefore, to 1990 Plan D ranks with Plan A and H at 5th lowest impact potential. due primarily to the exposure from the discharge at RM 79. After 1990, the surface water discharges are eliminated in favor of percolation disposal with strong potential for groundwater quality impact. The location selected for the C and NS disposal adjoining Long Lake impacts a relatively small groundwater body before emergence to surface water so that its impact on utilization of important groundwater bodies is small. The location chosen for SV disposal in the Mead area is also chosen to minimize the effect on the important groundwater body but does nevertheless impart a significant usable segment before the groundwater emerges as surface water. This plan is ranked as having the highest relative groundwater impact.

8. CONCERN FOR SURFACE WATER QUALITY

a. What is the relative potential of this plan for impact on surface water quality?

Plan D has two surface water discharges to 1990 as does Plan A and for that period has the same potential for impact on surface water quality. From 1990 all surface water discharges are eliminated in favor of percolation disposal. One percolation disposal parallel to Long Lake has a relatively short groundwater return path to the Lake through which the surface

water could possibly be impacted. Considering these exposures, this plan is ranked 3rd from lowest in surface water impact potential.

9. CONCERNS FOR LAND USE

What are the land use requirements of this candidate plan?

This plan is identical with Plan A to 1990 and to that date requires only an additional 12 acres site for treatment plant. After 1990 two percolation sites are required, one of approximately 500 acres of natural wooded lands on the north bank of Long Lake and the other of approximately 144 acres of rural land in vicinity of Mead. There would be significant negative impacts resulting primarily from the Long Lake site on habitat and aesthetic values. The Long Lake site also has potential for other uses ranging from open space to residential and recreation. The Mead site interferes with industrial and residential uses.

a. What relative impact will this plan have on the quantity or quality of land available for wildlife habitat, natural vegetation and open space?

Ranks 7th in preservation.

b. What relative impact will this plan have on the aesthetic quality of the landscape?

Ranks 7th in preservation.

c. What constraints will this plan place on other beneficial uses of land?

Ranks 8th in minimizing constraints.

10. CONCERNS FOR AIR QUALITY

a. What relative effect will the implementation of this plan alternative have on the public health aspects of air quality?

No negative impact. Ranks with Plans A, C and H which also have no negative impact.

b. What relative effect will the implementation of this plan alternative have on the aesthetic aspects of air quality?

The percolation lagoons have a small potential for odor production if surface layers become clogged. Ranks as 5th from lowest in odor potential.

11. CONCERNS FOR ENERGY AND RESOURCES

a. How does this project compare with other plan alternatives with respect to the need for:

1) Electrical energy input?

Has 5th lowest energy requirement (556.1×10^6 kwh). The increase over Plan A is due entirely to the disposal conveyance pumping to percolation disposal after 1990.

2) Thermal energy input?

Negligible for all plans.

b. How does this plan alternative compare with other alternatives with respect to need for consumption of chemcials or other consumable resources which may be in short supply?

Ranks 5th lowest in chemical requirements. Although alum usage for phosphorus removal is cut by switch to percolation disposal in 1990, there is significant requirement for methanol for denitrification of SV flows after 1990.

c. What positive aspects does this plan alternative have with respect to salvage of energy or reusable chemical resources?

Up until 1990, the entire flow from the three service areas is discharged to the Spokane River and becomes available for hydro power production. After 1990 there is no direct discharge to river but C+NS are expected to percolate to Long Lake and be available for hydro power from Long Lake down. There is no recovery of nutrient chemicals. Ranks lowest in potential resource recovery along with Plans E and G.

d. How does this plan compare with other plan alternatives in net energy requirements after considering credits for resource recovery potential?

Ranks 4th lowest in net energy requirement as a result of combining 5th ranked input needs lower ranked recovery potential. (493×10^6 kwh net.)

12. PERFORMANCE EVALUATION

a. How does this plan alternative compare with others in technical performance toward releasing to the environment the highest quality renovated wastewater?

The surface water discharges to 1990 are ranked identical with Plan A, but addition of land percolation treatment after 1990 increase net ranking to 3rd in quality

b. How does this plan alternative compare with others in reliability of technical performance?

Low reliability prior to 1990 is corrected by the inherent storage capability of land percolation after 1990 raising ranks to 3rd for reliability.

13. FLEXIBILITY

a. How does this plan alternative rate for its flexibility in being adaptable to unanticipated changes in rate and location of growth?

This plan is identical to Plan A to 1990 and has the same flexibility characteristics to that date. This delay in going to more refined treatment is in itself an advantage to flexibility. Beyond 1990, there are major conveyance structures for both the C and NS flows and the SV flows which would introduce inflexibility. The percolation treatment, however, can be expanded in stages. Due primarily to the long conveyance lines after 1990, this plan is ranked 4th in flexibility.

b. How does this plan alternative rate for its flexibility in adapting to possible changes in water quality criteria and goals?

This plan with two elements to surface water but with planned conversion tc percolation disposal is ranked 3rd highest in flexibility to meet changing criteria. The possible increases in groundwater criteria concurrent with surface wtaer criteria is the consideration that ranks this plan lower than the plans which utilize irrigation.

c. How does this plan alternative rate for flexibility in being able to utilize future changes in technology of wastewater treatment?

This plan and Plan A with two concentrated site plants is ranked 3rd in flexibility.

NARRATIVE EVALUATION

ALTERNATIVE PLAN: "E"

PLAN ELEMENTS: (C+NS)-sw-li; SV-li

DESCRIPTION: City and North Spokane combined to summer season land irrigation and winter season surface water; Spokane Valley separately to land irrigation.

1. COST-EFFECTIVENESS EVALUATION

a. Capitalized Cost Basis

Planning period facilities cost expressed as present worth, millions of dollars.

1) Total, including capital and O and M	95.1
2) Capital costs only, including land	77.5
3) Operation and maintenance costs only	17.6

b. Annualized Cost Basis

Planning period facilities cost expressed as equivalent equal annual cost, dollars per year.

1) Total, including capital and O and M	9.0
2) Capital costs only, including land	7.3
3) Operation and maintenance costs only	1.7

c. Capitalized cost of this project is 53.1 million dollars more than the most cost effective project.

2. DIRECT ECONOMIC CONCERNS

a. What relative impact will the capital funding of this plan alternative have on the tot 1 supply and availability of capital funds to meet other community needs?

Ranks 7th from lowest in capital fund requirements. Plans E and F are significantly higher than all other candidates.

b. What will be the relative impact of operation and maintenance costs of this plan alternative on utility rates and on tax rates?

Ranks 2nd from lowest in requirements for operation and maintenance costs due to the offsetting income from crop income.

Plan F is lower because unit crop income is higher in Little Spokane Valley than in Airways Heights area.

c. What relative impact will any displacements caused by this plan alternative have on employment and community real income?

Ranks 5th from lowest three plans in displacement potential due to requirements for in excess of 15,000 acres in Peone Prairie and Airways Heights areas.

d. What relative impact will any displacements caused by this plan alternative have on tax income of the community?

Lands with approximate market value $5,000,000 are taken from the tax rolls for implementation. Ranks 7th from lowest in minimizing loss of tax revenue.

3. INDIRECT ECONOMIC CONCERNS

a. What relative impact will this plan alternative have on the general desirability of this area as a place to operate a business which will be reflected in the rate of economic development of the area? What relative impact will this plan alternative have on the general level of economic activity of the area which will be reflected in property values and tax income of the community?

Although this plan is judged to have comparable attractiveness to business and increased economic development as others, the negative impacts of cost on tax and utility rates for this plan make it rank lower than Plans A, B, C, D, G and H but higher than Plan F.

4. TRANSIENT ECONOMIC CONCERNS

a. What will be the relative impact of project construction on local employment during the construction period based on this plan alternative?

Local potential for increased employment during construction ranks 2nd due to large expenditures for conveyance and earthwork structures.

b. What relative impact will the construction of this plan alternative have on local manufacturing and materials supply business?

Potential for increased sale of local materials and products during construction ranks 2nd due to the large volume of pipe in irrigation work.

c. What relative impact will the construction of this plan alternative have on temporary disruptions of circulation and/or business activity that will result in reduced employment or other economic loss?

This plan along with Plans D, F and G ranks 4th from lowest in disruption potential. All have approximately 7 miles of disposal conveyance for Spokane Valley through moderately built-up area and from 4 to 7 miles of service conveyance parallel to traveled roads for North Spokane. There are differing amounts of rural road conveyance for Plans D, E, F and G which are judged to not significantly affect ranking.

5. SOCIAL CONCERNS FOR THE COMMUNITY

a. What relative impact will this plan alternative have on the health, welfare and safety of the community?

All candidate plans are formulated to have a strong positive impact on health, welfare and safety. The screening of potential negative impacts indicates that this plan has exposures associated with surface water limited to winter season, irrigation and raw sewage pumping and has limited exposures associated with groundwater from irrigation percolation. This plan is ranked 3rd in risk along with Plans C, G and H.

b. Will the implementation of this plan alternative cause disruptions of existing community living patterns such as location, quality and character of residential communities, locations and kinds of employment and general cultural activities?

This plan will have major disruptive impact potential on significant rural areas totaling approximately 15,000 acres. This plan is ranked next highest in disruptive impact to Plan F.

c. What relative impact will this plan alternative have on the recreation patterns of the community?

All surface water disposal is eliminated except during the winter season providing unrestricted recreation use in summer. There are significant land diversions to wastewater management use that could negatively impact recreation opportunities. Relative ranking is 2nd from highest for potential improvement of recreational opportunities.

d. What relative impact will this plan alternative have on land use and land use planning?

All plans, except the no action plan, by solving area wide wastewater management problems, remove one of the constraints on development thereby making land planning an essential for controlled development. This plan preempts approximately 15,000 acres for wastewater management and thus ranks 2nd highest in physical constraints on land use.

6. SOCIAL CONCERNS FOR THE INDIVIDUAL

a. Will the implementation of this plan alternative cause dislocations which will effect the place of residence, employment, mobility and general cultural activity of a significant number of individuals?

This plan ranks 5th from lowest in potential for individual locations due to the large areas taken for wastewater management.

b. To what extent will the implementation of this plan impact individual life style?

All plans have negligible impact on general life style.

7. CONCERN FOR GROUNDWATER QUALITY

a. What is the relative potential of this plan for impact on groundwater quality?

Plan E has surface water discharge at one location, the City STP, and in the winter season only. From the standpoint of surface water discharges, this plans ranks with Plan C as having low groundwater exposure potential. The storage and irrigation on the surface of the basalt aquifer create a relatively strong potential for percolation to groundwater due to the unique geological conditions. The relatively thin overburden of coarse materials and the jointing of the basalt provide pathways for the percolate to reach the basalt aquifer. The coarse materials and the basalt joints are paths that have low capability for wastewater renovation. There is also an irrigation disposal to Peone Prairie as in Plans B and G with relatively low groundwater impact potential due to fine overburden materials and discontinuous aquifer. Due primarily to the exposure from irrigation and storage on the surface of the basalt aquifer this plan is ranked 6th from lowest in groundwater impact potential.

8. CONCERN FOR SURFACE WATER QUALITY

a. What is the relative potential of this plan for impact on surface water quality?

Plan E has a single surface water discharge at the City STP which operates during the winter season only. The winter season exposure not only reduces the time during which downstream quality would be less than natural but greatly reduces both the opportunity for and impact of a malfunction. The lessening of impact in winter is due to higher dilution, and lower temperatures. In the case of recreation concerns, the impact is minimal due to the decreased need. For these reasons, this plan is ranked 2nd from lowest in surface water impact potential.

9. CONCERNS FOR LAND USE

What are the land use requirements of this candidate plan?

This plan requires two major land acquisitions, one of approximately 11,000 acres in the Airways Heights area and one of approximately 4,500 acres in the Peone Prairie area. The Airways Heights area is mostly dry farmed but not as intensively as Peone Prairie. Although the area required in Airways Heights is larger, the significance of the area as habitat, natural cover and aesthetic value is rated lower than the Peone Prairie. As noted under Plan B, there are significant negative habitat and aesthetic impacts involved in utilization of Peone Prairie lands. On the other hand, the proximity of the Airways Heights area to the City points to its possible long term alternative demands for its use for industrial or other urban purposes. This plan is ranked as follows.

a. What relative impact will this plan have on the quantity or quality of land available for wildlife habitat, natural vegetation and open space?

Ranks 4th in preservation.

b. What relative impact will this plan have on the aesthetic quality of the landscape?

Ranks 5th in preservation.

c. What constraints will this plan place on other beneficial uses of land?

Ranks 6th in minimizing constraints.

10. CONCERNS FOR AIR QUALITY

a. What relative effect will the implementation of this plan alternative have on the public health aspects of air quality?

There is potential for aerosol contamination of the air from the approximately 14,000 acres total of irrigation at two separate locations. Ranks as having the highest exposure to air contamination along with Plan F, due not only to area but the two locations and the nearness to population centers.

b. What relative effect will the implementation of this plan alternative have on the aesthetic aspects of air quality?

Small odor potential exists at both irrigation areas and both storage areas. As for health considerations, the multiple sites and nearness to population centers cause this plan to rank highest in potential for odor problems.

11. CONCERNS FOR ENERGY AND RESOURCES

a. How does this project compare with other plan alternatives with respect to the need for:

1) Electrical energy input?

Has next to highest energy requirement (921.4×10^6 kwh), approximately twice the level of all surface water disposal. High energy use caused by disposal conveyance to irrigation, part year for C+NS and all year for SV.

2) Thermal energy input?

Negligible for all plans.

b. How does this plan alternative compare with other alternatives with respect to need for consumption of chemicals or other consumable resources which may be in short supply?

Ranks lowest in chemical requirements together with Plan F since neither phosphorus* removal nor denitrification are required. (*Assuming that only seasonal phosphorus removal is required.)

c. What positive aspects does this plan alternative have with respect to salvage of energy or reusable chemical resources?

Although the C+NS flow discharges to the Spokane River for the entire winter season, the hydro power potential is negligible since natural flows exceed installed plant capacity much of the winter. There is nutrient recovery for the summer C+NS flows and year around for SV. Ranks lowest in resource recovery potential along with Plans D and G.

d. How does this plan compare with other plan alternatives in net energy requirements after considering credits for resource recovery potential?

Ranks next to highest in net energy requirement due to combination of high input and low recovery. (860×10^6 kwh net.)

12. PERFORMANCE EVALUATION

a. How does this plan alternative compare with others in technical performance toward releasing to the environment the highest quality renovated wastewater?

Full time irrigation treatment for SV service area and summer season irrigation treatment for C and NS service areas combined provide high quality ranking but winter surface water discharge for the latter detracts from ranking. Plan is

ranked 4th for quality.

b. How does this plan alternative compare with others in reliability of technical performance?

Irrigation treatments and associated storage provide high reliability. The feature which detracts from reliability is the winter surface discharge. Plan is ranked 4th for reliability.

13. FLEXIBILITY

a. How does this plan alternative rate for its flexibility in being adaptable to unanticipated changes in rate and location of growth?

This plan has major conveyance systems associated with both plan elements. The one associated with the SV service area to the irrigation site is common to Plan F. The conveyance from the City STP to Airways Height area is relatively short but involves a river crossing and high head pumping. Both plan elements involve the inflexible concerns of storage reservoirs. This plan is ranked 6th in flexibility above Plan F which has much longer conveyance and Plan C which has major conveyance through the City.

b. How does this plan alternative rate for its flexibility in adapting to possible changes in water quality criteria and goals?

Irrigation disposal is used for both elements in this plan, but for one element surface water disposal is required for the winter season. This latter feature makes this plan relatively inflexible since the irrigation site utilized is not large enough to permit ceasing the winter disposal to surface water and other alternatives would have to be explored. This plan is ranked 4th in flexibility.

c. How does this plan alternative rate for flexibility in being able to utilize future changes in technology of wastewater treatment?

This plan and Plan F with one concentrated site plant at the City STP site and one lagoon facility is ranked 2nd in flexibility. Ranking is below Plan G because more of the City site capability is used by including the NS service area.

NARRATIVE EVALUATION

ALTERNATIVE PLAN: "F"

PLAN ELEMENTS: (C+NS)-1i; SV-1i

DESCRIPTION: City and North Spokane combined to land irrigation, Spokane Valley separately to land irrigation.

1. COST-EFFECTIVENESS EVALUATION

a. Capitalized Cost Basis

Planning period facilities cost expressed as present worth, millions of dollars.

1)	Total, including capital O and M	132.2
2)	Capital costs only, including land	118.1
3)	Operation and maintenance costs only	14.1

b. Annualized Cost Basis

Planning period facilities cost expressed as equivalent equal annual cost, dollars per year.

1)	Total, including capital and O and M	12.5
2)	Capital costs only, including land	11.2
3)	Operation and maintenance costs only	1.3

c. Capitalized cost of this project is 90.2 million dollars more than the most cost effective project.

2. DIRECT ECONOMIC CONCERNS

a. What relative impact will the capital funding of this plan alternative have on the total supply and availability of capital funds to meet other community needs?

Ranks highest in capital fund requirements by a large margin.

b. What will be the relative impact of operation and maintenance costs of this plan alternative on utility rates and/or tax rates?

Ranks lowest in requirements for mean annual operation and maintenance costs due to the offsetting credit for crop revenue.

c. What relative impact will any displacements caused by this plan alternative have on employment and community real income?

Ranks highest in displacement potential due to requirements for in excess of 18,000 acres for treatment lagoon, storage reservoirs and irrigation lands.

d. What relative impact will any displacements caused by this plan alternative have on tax income of the community?

Lands with approximate market value $12,000,000 are taken from the tax rolls for implementation. Ranks highest in displacement of lands from tax rolls, more than twice the 7th ranked plan.

3. INDIRECT ECONOMIC CONCERNS

a. What relative impact will this plan alternative have on the general desirability of this area as a place to operate a business which will be reflected in the rate of economic development of the area? What relative impact will this plan alternative have on the general level of economic activity of the area which will be reflected in property values and tax income of the community?

Although this plan is judged to have comparable attractiveness to business and increased economic development as others, the negative impacts of costs on taxes and utility rates are highest of any plan. Therefore, this plan is ranked lowest in net attractiveness to business and economic growth.

4. TRANSIENT ECONOMIC CONCERNS

a. What will be the relative impact of project construction on local employment during the construction period based on this plan alternative?

Local potential for increased employment during construction ranks first due to the very large expenditures for conveyance, irrigation and earthwork facilities.

b. What relative impact will the construction of this plan alternative have on local manufacturing and materials supply business?

Potential for increased sales of local materials and products during construction is highest of all plans due to very large volume of pipeline and irrigation facilities.

c. What relative impact will the construction of this plan alternative have on temporary disruptions of circulation and/or business activity that will result in reduced employment or other economic loss?

This plan along with Plans D, E and G ranks 4th from lowest

in disruption potential. All have approximately 7 miles of disposal conveyance for Spokane Valley through moderately built-up area and from 4 to 7 miles of service conveyance parallel to traveled roads for North Spokane. There are differing amounts of rural road conveyance for Plans D, E, F, and G which are judged to not significantly affect ranking.

5. SOCIAL CONCERNS FOR THE COMMUNITY

a. What relative impact will the implementation of this plan alternative have on the health, welfare and safety of the community?

All candidate plans are formulated to have a strong positive impact on health, welfare and safety. The screening of potential negative impacts indicates that this plan has exposures associated with irrigation and raw sewage pumping and has no exposures associated with surface water, and limited groundwater exposure associated with percolation from irrigation. This plan is ranked lowest in overall risk along with Plan D.

b. Will the implementation of this plan alternative cause disruptions of existing community living patterns such as location, quality and character of residential communities, locations and kinds of employment and general cultural activities?

This plan will have a major disruptive impact potential on significant rural areas of approximately 18,900 acres taken for wastewater management. This plan is ranked highest in disruptive impact.

c. What relative impact will this plan alternative have on the recreation patterns of the community?

This plan provides for complete elimination of surface water disposal and thus maximizes the opportunity for use of the Spokane River for recreation. The large land area taken for irrigation in the Williams Valley diminishes the recreational opportunities in that area for hunting and similar part-time use of agricultural areas. Plan ranks 1st in increased opportunities for recreation.

d. What relative impact will this plan alternative have on land use and land use planning?

All plans, except the no action plan, by solving area-wide wastewater management problems, removes one of the constraints to development thereby making land use planning essential for controlled development. This plan preempts more land for wastewater management than any other and thus has highest impact on land use.

6. SOCIAL CONCERNS FOR THE INDIVIDUAL

a. Will the implementation of this plan alternative cause dislocations which will effect the place of residence, employment, mobility and general cultural activity of a significant number of individuals?

This plan in taking the largest area for wastewater management has the highest potential for individual dislocation.

b. To what extent will the implementation of this plan impact individual life style?

All plans have negligible impact on general life style.

7. CONCERN FOR GROUNDWATER QUALITY

a. What is the relative potential of this plan for impact on groundwater quality?

Plan F relies entirely on irrigation disposal. The greatest potential for impact on groundwater exists in that part of the plan that proposes irrigation of approximately 12,100 acres in the Williams Valley. This area is underlain with lesser but significant groundwater body. The soils are fine but well drained and the depth to groundwater and bedrock is not great, hence, there is an expectation of some impact on groundwater quality from percolation. The irrigation site in Peone Prairie for SV flows is less permeable and the groundwater body less extensive so that the potential for impact is lower at this site. Due primarily to the exposure in the Williams Valley, this plan is rated as having the 2nd lowest groundwater impact potential.

8. CONCERN FOR SURFACE WATER QUALITY

a. What is the relative potential of this plan for impact on surface water quality?

Plan F provides for elimination of surface water discharges and therefore, neglecting malfunction of pumping and conveyance facilities, should provide the maximum protection of surface waters for all beneficial uses. This plan is ranked as having the lowest potential impact on surface water quality. Although this plan is rated as lowest in potential impact, it does not rate as no potential impact. The Williams Valley irrigated area is traversed by many streams tributary to the Little Spokane River. The change in land use to concentrated irrigation will undoubtedly impact these streams. Overirrigation and runoff could likewise impact these streams. These same concerns are true but to a much smaller extent in the Peone Prairie irrigation area.

9. CONCERNS FOR LAND USE

What are the land use requirements of this candidate plan?

This plan requires the largest land acquisition of any, approximately 14,800 acres in the Williams Valley area and approximately 4,500 acres in the Peone Prairie area. The Peone Prairie requirement is the same as for Plan E and similar to that for Plan B and G. The Williams Valley area is farmed largely as dry or irrigated pasture but the area is interspersed with wood lots. Due both to the size and the character of lands involved at both sites, this plan is judged to have strong negative impact on habitat and aesthetic values. Alternative uses for the land are primarily in kind of agriculture, hence, the negative impact in this category are lower than the size of the areas alone would indicate. This plan is rates as follows:

a. What relative impact will this plan have on the quantity or quality of land available for wildlife habitat, natural vegetation and open space?

Ranks 6th in preservation.

b. What relative impact will this plan have on the aesthetic quality of the landscape?

Ranks 6th in preservation.

c. What constraints will this plan place on other beneficial uses of land?

Ranks 5th in minimizing constraints.

10. CONCERNS FOR AIR QUALITY

a. What relative effect will the implementation of this plan alternative have on the public health aspects of air quality?

There is potential for aerosol contamination from 17,500 acres of total irrigation at two sites. Although the total area in Plan F is greater than in Plan E, the exposure potential is judged to be not significantly different, since one of the areas in Plan F is more remotely located. Ranks with Plan E as having highest exposure potential.

b. What relative effect will the implementation of this plan alternative have on the aesthetic aspects of air quality?

There is small odor production potential from both irrigation and both storage areas. Ranks at 6th lowest as an odor potential problem due to remote location of one area and one storage reservoir.

11. CONCERNS FOR ENERGY AND RESOURCES

a. How does this project compare with other plan alternatives with respect to the need for:

1) Electrical energy input?

Has highest energy requirement (1281.3×10^6 kwh) due to high disposal pumping heads for entire year flows to irrigation for all 3 service areas. Requirement is more than 3 times the requirement for surface water disposal.

2) Thermal energy input?

Negligible for all plans.

b. How does this plan alternative compare with other alternatives with respect to need for consumption of chemicals or other consumable resources which may be in short supply?

Ranks lowest in chemical requirements with Plan E since all flows are to irrigation disposal and neither phosphorus removal or denitrification are required.

c. What positive aspects does this plan alternative have with respect to salvage of energy or reusable chemical resources?

Provides nc potential for hydro power energy recovery. Nutrients are recovered for entire service area by all flows to irrigation. The energy equivalent of the nitrogen fertilizer recovery is approximately equal to the hydro power potential of Plans A, B, C and H so that this plan ranks with these plans in recovery potential.

d. How does this plan compare with other plan alternatives in net energy requirements after considering credits for resource recovery potential?

Ranks highest in net energy requirement due to highest input requirement by such a large margin that high ranked recovery potential does not significantly reduce net (1157×10^6 kwh net).

12. PERFORMANCE EVALUATION

a. How does this plan alternative compare with others in technical performance toward releasing to the environment the highest quality renovated wastewater?

Full time land treatment by irrigation for all flows give this plan 1st rank for quality.

b. How does this plan alternative compare with others in reliability of technical performance?

Storage provided for land treatment for all flows gives this plan 1st rank for reliability.

13. FLEXIBILITY

a. How does this plan alternative rate for its flexibility in being adaptable to unanticipated changes in rate and location of growth?

Plan F, like Plan E, has major conveyance facilities and storage reservoirs associated with both plan elements. The SV service area element is identified with Plan E. The conveyance from City STP to Williams Valley is the longest of any plan and would constitute a major problem for enlargement to meet unforeseen growth. This plan is ranked as being least flexible.

b. How does this plan alternative rate for its flexibility in adapting to possible changes in water quality criteria and goals?

Complete disposal by irrigation for both elements makes this plan free of surface water criteria changes and relatively free of groundwater criteria changes. This plan is ranked as being most independent of possible criteria changes which is construed as being "flexible" to meet possible changes.

c. How does this plan alternative rate for flexibility in being able to utilize future changes in technology of wastewater treatment?

This plan and Plan E with one concentrated site plant at the City STP site and one lagoon facility is ranked 2nd in flexibility.

NARRATIVE EVALUATION

ALTERNATIVE PLAN: "G"

PLAN ELEMENTS: (NS+SV)-li; C-sw/lp

DESCRIPTION: North Spokane and Spokane Valley combined to land irrigation; City separately to surface water until 1990 then to land percolation.

1. COST-EFFECTIVENESS EVALUATION

a. Capitalized Cost Basis

Planning period facilities cost expressed as present worth, millions of dollars.

1) Total, including capital and O and M	70.4
2) Capital costs only, including land	49.5
3) Operation and maintenance costs only	20.9

b. Annualized Cost Basis

Planning period facilities cost expressed as equivalent equal annual cost, dollars per year.

1) Total, including capital and O and M	6.6
2) Capital costs only, including land	4.6
3) Operation and maintenance costs only	2.0

c. Capitalized cost of this project is 28.4 million dollars more than the most cost effective project.

2. DIRECT ECONOMIC CONCERNS

a. What relative impact will the capital funding of this plan alternative have on the total supply and availability of capital funds to meet other community needs?

Ranks 6th from lowest in capital fund requirements.

b. What will be the relative impact of operation and maintenance costs of this plan alternative on utility rates and/or tax rates?

Ranks 3rd from lowest in requirements for mean annual operation and maintenance funds. Rank is closer to Plans A, B, C, D and H since the offsetting crop revenue applies to only part of the

entire system.

c. What relative impact will any displacements caused by this plan alternative have on employment and community real income?

Ranks 4th from lowest three plans in displacement potential due to requirements for in excess of 6,000 acres in Peone Prairie for lagoons, storage and irrigation.

d. What relative impact will any displacements caused by this plan alternative have on tax income of the community?

Lands with approximate market value $4,200,000 are taken from the tax rolls for implementation. Ranks 6th from lowest in minimizing loss of tax revenue.

3. INDIRECT ECONOMIC CONCERNS

a. What relative impact will this plan alternative have on the general desirability of this area as a place to operate a business which will be reflected in the rate of economic development of the area? What relative impact will this plan alternative have on the general level of economic activity of the area which will be reflected in property values and tax income of the community?

Plans A, B, C, D, G and H are judged to have comparable attractiveness to business and increased economic development. They offer comparable community attractiveness benefits and comparable effect on the general level of taxes and utility rates. These plans are ranked together as having the most favorable impact on economic development.

4. TRANSIENT ECONOMIC CONCERNS

a. What will be the relative impact of project construction on local employment during the construction period based on this plan alternative?

Local potential for increased employment during construction ranks 3rd due to moderately large expenditures for conveyance, irrigation and earthwork facilities.

b. What relative impact will the construction of this plan alternative have on local manufacturing and materials supply business?

Potential for increased sales of local materials and products during construction ranks 3rd due to moderate volumes of pipe and irrigation facilities.

c. What relative impact will the construction of this plan alternative have on temporary disruptions of circulation and/or business activity that will result in reduced employment or other economic

loss?

This plan along with Plans D, E and F ranks 4th from lowest in disruption potential. All have approximately 7 miles of disposal conveyance for Spokane Valley through moderately built-up area and from 4 to 7 miles service conveyance parallel to traveled road for North Spokane. There are differing amounts of rural road conveyance for Plans D, E, F and G which are judged to not significantly affect ranking.

5. SOCIAL CONCERNS FOR THE COMMUNITY

a. What relative impact will this plan alternative have on the health, welfare and safety of the community?

All candidate plans are formulated to have a strong positive impact on health, welfare and safety. The screening of potential negative impacts indicates that this plan has exposures associated with surface water for only half the planning period, irrigation and raw sewage pumping and has limited exposures associated with groundwater, only the percolation from irrigation. This plan is ranked 3rd from lowest risk along with Plans C, E and H.

b. Will the implementation of this plan alternative cause disruptions of existing community living patterns such as location, quality and character of residential communities, locations and kinds of employment and general cultural activities?

There will be community disruption caused by preempting approximately 6700 acres for lagoons, storage and irrigation. This plan is ranked 4th from lowest in disruptive impact.

c. What relative impact will this plan alternative have on the recreation patterns of the community?

From 1980 to 1990, surface water disposal to 1983 standards provides greatly improved recreation availability of the Spokane River and Long Lake, but not without some reservation. Unlike plans A, B, and C, there is no surface water discharge above the City STP. After 1990 there would be complete elimination of surface water discharge which would remove all reservation. There are some land diversions to wastewater management that could negatively impact recreation opportunities, particularly the attractive area on Long Lake taken for percolation. Plan ranks 4th from highest for improvement of recreational opportunities.

d. What relative impact will this plan alternative have on land use and land use planning?

All plans, except the no action plan, by solving area-wide wastewater management problems, remove one of the constraints to development thereby making land use planning an essential for controlled development. This plan physically constrains land use and land use planning in the 6700 acre area taken for wastewater management. Plan is ranked 4th from lowest in physical impact on land use.

6. SOCIAL CONCERNS FOR THE INDIVIDUAL

a. Will the implementation of this plan alternative cause dislocations which will effect the place of residence, employment, mobility and general cultural activity of a significant number of individuals?

This plan has dislocation impact in the 6700 acres taken for wastewater management. Ranks 4th from lowest in dislocation impacts.

b. To what extent will the implementation of this plan impact individual life style?

All plans have negligible impact on general life style.

7. CONCERN FOR GROUNDWATER QUALITY

a. What is the relative potential of this plan for impact on groundwater quality?

This plan like Plan C has only one surface water disposal point at the City STP and considering that portion of the plan has low potential for groundwater impact. The other element of the plan is irrigation disposal to the Peone Prairie which also forms an element of Plans B, E and F. As noted under these plans, this element also has low potential for significant groundwater impact. Therefore, Plan G is ranked 3rd to lowest in impact potential.

8. CONCERN FOR SURFACE WATER QUALITY

a. What is the relative potential of this plan for impact on surface water quality?

Plan G has a single surface water disposal at the City STP that serves the City service area. The potential impact of this plan is less than Plan C which has a similar single disposal in that Plan G flows are significantly smaller. Therefore Plan G is ranked 4th in potential impact above Plan C.

9. CONCERNS FOR LAND USE

What are the land use requirements of this candidate plan?

This plan has one major land requirement from the inception of the project for approximately 6,300 acres in the Peone Prairie area and another beginning in 1990 for approximately 434 acres for a percolation site on the north shore of Long Lake. The impacts of these two acquisitions is similar to Plans B, E and F relative to the Peone Prairie land and to Plan D for the Long Lake site. Both areas involve significant negative impacts to all three concerns, a combination that gives this plan as a whole a strong negative impact.

a. What relative impact will this plan have on the quantity or quality of land available for wildlife habitat, natural vegetation and open space?

   Ranks last in preservation.

b. What relative impact will this plan have on the aesthetic quality of the landscape?

   Ranks last in preservation.

c. What constraints will this plan place on other beneficial uses of land?

   Ranks 7th in minimizing constraints.

10. CONCERNS FOR AIR QUALITY

a. What relative effect will the implementation of this plan alternative have on the public health aspects of air quality?

   There is potential for aerosol contamination of air from irrigation of approximately 5500 acres at one location. Exposure potential is ranked as 3rd lowest, having one location and less area than Plans E and F but having more area than Plan B.

b. What relative effect will the implementation of this plan alternative have on the aesthetic aspects of air quality?

   There is odor potential from both the irrigation and storage areas and the percolation pond constructed after 1990. Plan is ranked 7th from lowest in odor potential.

11. CONCERNS FOR ENERGY AND RESOUCES

a. How does this project compare with other plan alternatives with respect to the need for:

   1) Electrical energy input?

      Has 6th lowest energy requirement (620.4×10^6 kwh). The lower energy requirement for lagoon treatment of

NS+SV flows is more than offset by service and disposal conveyance pumping. There is also added lift after 1990 for City to percolation disposal.

2) Thermal energy input?

Negligible for all plans.

b. How does this plan alternative compare with other alternatives with respect to need for consumption of chemicals or other consumable resources which may be in short supply?

Ranks 2nd lowest after Plans E and F. Alum for phosphorus removal is required only to 1990 for only the City portion of flow.

c. What positive aspects does this plan alternative have with respect to salvage of energy or reusable chemical resources?

The City flow to 1990 is the only flow disposal to the river for availability to hydro power production. Nutrients are recovered only for the NS+SV portion of flow to irrigation. Thus, total recovery potential is low, ranking with Plans D and E.

d. How does this plan compare with other plan alternatives in net energy requirements after considering credits for resource recovery potential?

Ranks 5th from lowest due to having 6th lowest input requirement and low recovery. (554×10^6 kwh net.)

12. PERFORMANCE EVALUATION

a. How does this plan alternative compare with others in technical performance toward releasing to the environment the highest quality renovated wastewater?

Land treatment by irrigation for the NS and SV service areas combined provide high quality rating. The City service area with surface water disposal to 1990 is phased into land treatment by percolation to give a good quality rating overall. Plan is ranked 2nd in quality.

b. How does this plan alternative compare with others in reliability of technical performance?

The irrigation and land percolation systems provide for high reliability but the overall plan is ranked 2nd in reliability in recognition of the early period of surface water disposal for the City service area.

13. FLEXIBILITY

a. How does this plan alternative rate for its flexibility in being adaptable to unanticipated changes in rate and location of growth?

Plan G has major conveyance facilities as part of both plan elements but those associated with the City service area are not to be constructed until 1990. The postponement of construction removes significant risk of unanticipated growth rates. Therefore, this plan is ranked 5th as more flexible than Plans C, E and F.

b. How does this plan alternative rate for its flexibility in adapting to possible changes in water quality criteria and goals?

This plan has irrigation disposal for service areas NS and SV and surface water separately for the City, changing to percolation at 1990. Until 1990, the system is only partially independent of changes in surface water criteria, but there is a planned change for the surface water disposal which could be advanced in time if necessary. Plan is rated 2nd most flexible.

c. How does this plan alternative rate for flexibility in being able to utilize future changes in technology of wastewater treatment?

This plan with only one concentrated site plant, City service area alone to City STP, and one lagoon type facility to serve NS+SV service areas is ranked 1st in flexibility.

NARRATIVE EVALUATION

ALTERNATIVE PLAN: "H"

PLAN ELEMENTS: C-sw; NS-sw; SV-sw

DESCRIPTION: City, North Spokane and Spokane Valley each separately to surface water

1. COST-EFFECTIVENESS EVALUATION

a. Capitalized Cost Basis

Planning period facilities cost expressed as present worth, millions of dollars.

1) Total, including capital and O and M	47.3
2) Capital costs only, including land	17.6
3) Operation and maintenance costs only	29.7

b. Annualized Cost Basis

Planning period facilities cost expressed as equivalent equal annual cost, dollars per year.

1) Total, including capital and O and M	4.5
2) Capital costs only, including land	1.7
3) Operation and maintenance costs only	2.8

c. Capitalized cost of this project is 5.3 million dollars more than the most cost effective project.

2. DIRECT ECONOMIC CONCERNS

a. What relative impact will the capital funding of this plan alternative have on the total supply and availability of capital funds to meet other community needs?

Ranks 2nd from lowest in capital cost requirements.

b. What will be the relative impact of operation and maintenance costs of this plan alternative on utility rates and/or tax rates?

Ranks highest in requirements for mean annual operating funds due to having three completely separate plants to operate. There is, however, little significant difference in rank between plans A, B, C, D and H which includes ranks 4 through 8.

c. What relative impact will any displacements caused by this plan alternative have on employment and community real income?

Ranks with Plans A and D as having lowest impact on employment and community income since there are no significant displacements in this plan.

d. What relative impact will any displacements caused by this plan alternative have on tax income of the community?

Lands with approximate market value of $62,500 are taken from the tax rolls for implementation. Ranks 3rd in minimizing loss of tax revenue.

3. INDIRECT ECONOMIC CONCERNS

a. What relative impact will this plan alternative have on the general desirability of this area as a place to operate a business which will be reflected in the rate of economic development of the area? What relative impact will this plan alternative have on the general level of economic activity of the area which will be reflected in property values and tax income of the community?

Plans A, B, C, D, G and H are judged to have comparable attractiveness to business and increased economic development. They offer comparable community attractiveness benefits and have comparable effect on the general level of taxes and utility rates. These plans are ranked together as having the most favorable impact on economic development.

4. TRANSIENT ECONOMIC CONCERNS

a. What will be the relative impact of project construction on local employment during the construction period based on this plan alternative?

Local potential for increased employment during construction is lowest. Moderate treatment plant expenditures are offset by the very small amount of conveyance work.

b. What relative impact will the construction of this plan alternative have on local manufacturing and materials supply business?

Potential for increased sales of local materials and products during construction is lowest due to the relatively small percent of local items in treatment plant construction which makes up most of the construction volume.

c. Will the construction of this plan alternative cause temporary disruptions of circulation and/or business activity that will result in reduced employment or other economic loss?

Ranks lowest in disruption potential since all service areas are separately treated and all are disposed to surface water thus minimizing both service and disposal conveyance.

5. SOCIAL CONCERNS FOR THE COMMUNITY

a. What relative impact will this plan alternative have on the health, welfare and safety of the community?

All candidate plans are formulated to have a strong positive impact on health, welfare and safety. The screening of potential negative impacts indicates that this plan has surface water exposure, no raw sewage pumping exposure and involves no risks to groundwater or through irrigation. Plan is ranked 3rd lowest risk along with Plans C, E and G.

b. Will the implementation of this plan alternative cause disruptions of existing community living patterns such as location, quality and character of residential communities, locations and kinds of employment and general cultural activities?

This plan, along with Plans A and C will have negligible disruptive impact on the community.

c. What relative impact will this plan alternative have on the recreation patterns of the community?

Provides high absolute improvement of surface water above present conditions but ranks below plans which completely eliminate surface water disposal. This plan provides three points of surface disposal which cause it to rank after other plans with two or one point. Does not divert any land to disposal use. Ranks lowest in potential for improved recreation opportunities.

d. What relative impact will this plan alternative have on land use and land use planning?

All plans, except the no action plan, by solving area-wide wastewater management problems remove one of the constraints to development thereby making land use planning an essential for controlled development. This plan does not preempt any extensive lands and thus ranks lowest in physical constraints on land use along with Plans A and C.

6. SOCIAL CONCERNS FOR THE INDIVIDUAL

a. Will the implementation of this plan alternative cause dislocations which will effect the place of residence, employment, mobility and general cultural activity of a significant number of individuals?

This plan, along with Plans A and C will cause negligible disruption of individuals.

b. To what extent will the implementation of this plan impact individual life style?

All plans have negligible impact on general life style.

7. CONCERN FOR GROUNDWATER QUALITY

a. What is the relative potential of this plan for impact on groundwater quality?

Plan H has three points of surface water disposal, two of which are as cited for Plan A. The third point for NS service area is at the Spokane River and Little Spokane River confluence and is judged to have no significant potential for groundwater impact. Therefore, Plan H is ranked with Plan A at 4th lowest in impact potential.

8. CONCERN FOR SURFACE WATER QUALITY

a. What is the relative potential of this plan for impact on surface water quality?

The three separate surface water disposals to 1983 standards proposed in this plan should, as stated for Plan A, meet all requirements to maintain Class A conditions in the receiving waters. Discharges at RM 79, the City STP and the Little Spokane confluence increase the area of influence and the opportunities for malfunction. Therefore, this plan is ranked as having the highest potential for impact on surface water quality.

9. CONCERNS FOR LAND USE

What are the land use requirements of this candidate plan?

This plan requires only two small treatment sites in addition to the land already committed to wastewater management, one of approximately 12 acres near Felts Field, the same as for Plan B, and one of approximately 9 acres in the vicinity of the Fish Hatchery or, alternatively in the vicinity of the Little Spokane River confluence. These small sites, with the exception of the subalternative confluence site, are judged to have small impact. The subalternative confluence site is judged to have significant negative habitat and aesthetic impact due to the nature of the area. The ranking below is for the basic alternative at the Fish Hatchery site, which has some negative habitat and aesthetic impact.

a. What relative impact will this plan have on the quantity or quality of land available for wildlife habitat, natural vegetation and

open space?

Ranks 3rd in preservation.

b. What relative impact will this plan have on the aesthetic quality of the landscape?

Ranks 3rd in preservation.

c. What constraints will this plan place on other beneficial uses of land?

Ranks 3rd in minimizing constraints.

10. CONCERNS FOR AIR QUALITY

a. What relative effect will the implementation of this plan alternative have on the public health aspects of air quality?

No negative impact. Ranks with plans A, C and D which also have no negative impact.

b. What relative effect will the implementation of this plan alternative have on the aesthetic aspects of air quality?

Odor problems are unlikely from well operated plants, but this plan with three plants increases exposure potential over those with only one or two. Ranks 3rd from lowest in odor potential.

11. CONCERNS FOR ENERGY AND RESOURCES

a. How does this project compare with other plan alternatives with respect to the need for:

1) Electrical energy input?

Has 3rd lowest energy requirement (440.7×10^6 kwh). Requires slightly more energy than Plan A since the advantages of combined treatment slightly outweigh the elimination of the NS service conveyance pumping.

2) Thermal energy input?

Negligible for all plans.

b. How does this plan alternative compare with other alternatives with respect to need for consumption of chemicals or other consumable resources which may be in short supply?

Ranks 4th with Plans A and C which have identical alum usages for phosphorus removal to surface waters for all three service

areas.

c. What positive aspects does this plan alternative have with respect to salvage of energy or reusable chemical resources?

The entire flow of all three service areas is discharged to the Spokane River and become available for power production in WWP dams and downriver Columbia installations. There is no recovery of nutrient chemicals. The direct hydro energy recovery potential of this plan and plans A, B, and C is approximately equal to the energy equivalent of recovered nitrogen fertilizer of Plan F giving Plans A, B, C, F and H equal rank. (125 to 135 x 10^6 kwh.)

d. How does this plan compare with other plan alternatives in net energy requirements after considering credits for resource recovery potential?

Ranks 2nd lowest in net energy requirement along with Plan B due to having the 3rd lowest basic input requirement and recovery potential equal to the highest ranked recovery. (309 x 10^6 kwh net.)

12. PERFORMANCE EVALUATION

a. How does this plan alternative compare with others in technical performance toward releasing to the environment the highest quality renovated wastewater?

Three separate surface water disposals from activated sludge plants give this plan the lowest quality rating.

b. How does this plan alternative compare with others in reliability of technical performance?

Three separate plants without storage to buffer malfunctions give this plan lowest reliability rating.

13. FLEXIBILITY

a. How does this plan alternative rate for its flexibility in being adaptable to unanticipated changes in rate and location of growth?

Three separate plants, one for each major service area, and no major conveyance facilities combine to make the plan rank as most flexible to unanticipated growth.

b. How does this plan alternative rate for its flexibility in adapting to possible changes in water quality criteria and goals?

Three separate plants with surface water disposal make this this plan least flexible to changes in surface water criteria.

c. How does this plan alternative rate for flexibility in being able to utilize future changes in technology of wastewater treatment?

The need for three separate concentrated site plants ranks this plan lowest in flexibility.

NARRATIVE EVALUATION

ALTERNATIVE PLAN: "I"

DESCRIPTION: NO ACTION. City to continue disposal to surface water of secondary effluent with phosphorus removal; North Spokane to continue partial service by interim facilities and remainder by on-site disposal; Spokane Valley to continue on-site disposal.

1. COST-EFFECTIVENESS EVALUATION

a. Capitalized Cost Basis

Planning period facilities cost expressed as present worth, millions of dollars.

1)	Total Cost, capital plus operation and maintenance	23.4*
2)	Capital costs only, including land	NONE
3)	Operation and maintenance costs only	23.4*

b. Annualized Cost Basis

Planning period facilities cost expressed as equivalent equal annual cost, dollars per year.

1)	Total including capital and O and M	2.2*
2)	Capital costs only, including land	NONE
3)	Operation and maintenance costs only	2.2*

c. Capitalized cost of this project is 18.6 million dollars less than the most cost effective action plan.

2. DIRECT ECONOMIC CONCERNS

a. What relative impact will the capital funding of this plan alternative have on the total supply and availability of capital funds to meet other community needs?

The no-action plan has no public funding requirements for capital. Private individuals would continue to have capital costs for new on-site disposal facilities.

b. What will be the relative impact of operation and maintenance

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*For maintenance and operation of City STP, only with full time P removal.

costs of this plan alternative on utility rates and/or tax rates?

The operation and maintenance costs of the City STP serving the City alone is 23.4 million dollars and serving the City plus North Spokane under Plan A is 24.8 million dollars. As regards C+NS the no action plan does not offer large savings. Spokane Valley has no public O&M cost under no-action but would cost 7.3 million dollars for SV under Plan A.**

c. What relative impact will any displacements caused by this plan alternative have on employment and community real income?

The no action plan would cause no displacement of persons already in residence or already employed. Since some areas may be unbuildable and some employment opportunities may not be built for lack of sewerage service, there is in effect a future potential loss of employment and community income.

d. What relative impact will any displacements caused by this plan alternative have on tax income of the community?

As indicated under c above, impact will be in loss of future tax income from residences and commercial construction that will not take place for lack of sewerage service in some areas.

3. INDIRECT ECONOMIC CONCERNS

a. What relative impact will this plan alternative have on the general desirability of this area as a place to operate a business which will be reflected in the rate of economic development of the area? What relative impact will this plan alternative have on the general level of economic activity of the area which will be reflected in property values and tax income of the community?

The restrictions on development in areas without sewerage service or acceptable on-site disposal will make the area as a whole less attractive and will tend to slow economic development.

4. TRANSIENT ECONOMIC CONCERNS

a. What will be the relative impact of project construction on local employment during the construction period based on this plan alternative?

**All costs are in terms of present worth for 20 year planning period with full time P removal.

Not applicable.

b. What relative impact will the construction of this plan alternative have on local manufacturing and materials supply business?

Not applicable.

c. What relative impact will the construction of this plan alternative have on temporary disruptions of circulation and/or business activity that will result in reduced employment or other economic loss?

Not applicable.

5. SOCIAL CONCERNS FOR THE COMMUNITY

a. What relative impact will this plan alternative have on the health, welfare and safety of the community?

1) The City area impact will be same as Plan A.

2) In the North Spokane area where there are significant areas of unsatisfactory performance of on-site disposal there will continue to be the threat from these conditions.

3) In the Spokane Valley where on-site performance is generally satisfactory regarding surface condition there will continue to be the as yet unevaluated threat to groundwater supplies due to percolation.

b. Will the implementation of this plan alternative cause disruptions of existing community living patterns such as location, quality and character of residential communities, locations and kinds of employment and general cultural activities?

The no action plan could eventually cause deterioration of the quality of some North Spokane areas. The no action plan's primary impact is on the future disruptions caused by lack of satisfactory sewerage service to all areas.

c. What relative impact will this plan alternative have on the recreation patterns of the community?

No significant impact.

d. What relative impact will this plan alternative have on land use and land planning?

The no action plan could place heavy constraints on land use

planning in North Spokane and Spokane Valley. In NS areas not suitable for on site disposal must remain undeveloped. In SV, depending upon interpretations of regulatory agencies, restrictions could range all the way from density to location to no further development at all.

6. SOCIAL CONCERNS FOR THE INDIVIDUAL

a. Will the implementation of this plan alternative cause dislocations which will effect the place of residence, employment, business mobility and general cultural activity of a significant number of individuals?

The impacts upon the individual are essentially the same as described for the community as a whole under 5 above.

b. To what extent will the implementation of this plan impact individual life style?

Not applicable.

7. CONCERNS FOR GROUNDWATER QUALITY

a. What is the relative potential of this plan for impact on groundwater quality?

The continuation of on site disposal in North Spokane has posed significant surface problems to the extent that there has been little concern for groundwater which is at much greater depth through finer materials than in Spokane Valley.

In Spokane Valley the primary concern of continuation of on site disposal is the potential threat to groundwater. Refer to Task Report Section 608. Regulatory bodies have not evaluated this threat in terms of public health. The exact nature of the present and future impact on groundwater has not at this time been satisfactorily evaluated. There is no doubt that the unevaluated threat of no-action is a widespread concern.

8. CONCERN FOR SURFACE WATER QUALITY

a. What is the relative potential of this plan for impact on surface water quality?

The impact of the no-action plan is not significantly different than action plans which provide surface water disposal from the City STP with secondary treatment. There being no surface water discharge for Spokane Valley, the no-action plan has less impact on the upper part of the Spokane River than action plans which

utilize a local surface water disposal to Spokane Valley.

9. CONCERNS FOR LAND USE

What are the land use requirements of this candidate plan?

Not applicable.

a. What relative impact will this plan have on the quantity or quality of land available for wildlife habitat, natural vegetation and open space?

   The no-action plan has no impact on current land availability. The fact that the no action plan may prevent development of certain areas will tend to preserve some existing open space.

b. What relative impact will this plan have on the aesthetic quality of the landscape?

   No change over present conditions.

c. What constraints will this plan place on other beneficial uses of land?

   This plan will not preempt land.

10. CONCERNS FOR AIR QUALITY AND NOISE

a. What effect will the implementation of this plan alternative have on the public health aspects of air quality?

   No effect except that areas with poorly performing on-site disposal may provide the environment to encourage insect disease vectors.

b. What effect will the implementation of this plan alternative have on the aesthetic aspects of air quality?

   Areas where there is poorly performing on-site disposal are subject to odor nuisance.

c. What will be the relative impact of this plan alternative with respect to noise.

   Not applicable.

11. CONCERNS FOR ENERGY AND RESOURCES

a. How does this project compare with other plan alternatives with

respect to the need for:

1) Electrical energy input?

   The only significant energy requirement is for the City STP. The no-action plan avoids the energy for conveyance of North Spokane flows and the energy for conveyance and/or treatment of Spokane Valley flows.

2) Thermal energy input?

   Negligible for all plans including no-action.

b. How does this plan alternative compare with other alternatives with respect to need for consumption of chemicals or other consumable resources which may be in short supply?

   The consumption of chemicals for phosphorus removal for the City flow is same as action plans with surface water disposal.

c. What positive aspects does this plan alternative have with respect to salvage of energy or reusable chemical resources?

   Provides no salvage of chemical resources. The water going to on-site disposal is largely lost to energy production in passing down the Spokane River

d. How does this plan compare with other plan alternatives in net energy requirements after considering credits for resource recovery potential?

   The net energy requirement is lower than any action plan.

12. PERFORMANCE EVALUATION

a. How does this plan alternative compare with others in technical performance toward releasing to the environment the highest quality renovated wastewater?

   The City component is equal to action plans with secondary treatment to surface water disposal. All on-site disposal releases a low quality effluent to the environment.

b. How does this plan alternative compare with others in reliability of technical performance?

   The City STP component is as reliable as action plans. On-site disposal is reliable when maintained but has the weakness of presently being left to each individual.

13. FLEXIBILITY

a. How does this plan alternative rate for its flexibility in being adaptable to unanticipated changes in rate and location of growth?

Has highest flexibility in the sense that this plan leaves the City STP with large reserve capacity and that on-site disposal is completely flexible in its one to one response to need. The on-site disposal is not flexible to location and may prevent growth in certain areas.

b. How does this plan alternative rate for its flexibility in adapting to possible changes in water quality criteria and goals?

On-site disposal component has low flexibility to adapt to a change in requirements since it involves a large number of units with essentially fixed quality.

c. How does this plan alternative rate for flexibility in being able to utilize future changes in technology of wastewater treatment?

On-site disposal has low flexibility to adopt technological change since it would require large numbers of individuals to make capital expenditures. The potential for technological improvements that can be used on an individual basis is also a constraint.

NARRATIVE EVALUATION

ALTERNATIVE PLAN: "J"

PLAN ELEMENTS: (C+NS)-sw/swt; SV-sw/swt

DESCRIPTION: City and North Spokane combined to surface water disposal; Spokane Valley separately to surface water disposal. Both upgraded to 1985 standards in 1990 by addition of tertiary treatment elements.

1. COST-EFFECTIVENESS EVALUATION

a. Capitalized Cost Basis

Planning period facilities cost expressed as present worth, millions of dollars.

1)	Total, including capital and O and M	70.9
2)	Capital costs only, including land	32.0
3)	Operation and maintenance costs only	38.9

b. Annualized Cost Basis

Planning period facilities cost expressed as equivalent equal annual cost, dollars per year.

1)	Total, including capital and O and M	6.7
2)	Capital costs only, including land	3.0
3)	Operation and maintenance costs only	3.7

c. Capitalized cost of this project is 12.9 million dollars more than the most cost effective project (Plan D) providing 1985 standards.

2. DIRECT ECONOMIC CONCERNS

a. What relative impact will the capital funding of this plan alternative have on the total supply and availability of capital funds to meet other community needs?

Has lowest capital fund requirements initially in 1980, being the same as Plan A. The increment in 1990 is higher than Plan D.

b. What will be the relative impact of operation and maintenance costs of this plan alternative on utility rates and/or tax rates?

To 1990 this plan has the same costs as Plan A which ranks 5th

from lowest requirement for mean annual operation and maintenance funds. After 1990 its costs would be the highest of all alternatives.

c. What relative impact will any displacements caused by this plan alternative have on employment and community real income?

   Ranks with Plans A, D and H as having lowest impact on employment and community income since there are no significant displacements in this plan.

d. What relative impact will any displacements caused by this plan alternative have on tax income of the community?

   Up until 1990, this plan ranks 2nd from lowest in land requirements with Plan A. After 1990 the main impact is additional land to expand City STP site. Despite high unit cost, the value of land taken would be lower than Plans D or F.

3. INDIRECT ECONOMIC CONCERNS

   a. What relative impact will this plan alternative have on the general desirability of this area as a place to operate a business which will be reflected in the rate of economic development of the area? What relative impact will this plan alternative have on the general level of economic activity of the area which will be reflected in property values and tax income of the community?

      Due to the higher operating costs after 1990, this plan is ranked below Plans A, B, C, D, G and H which are judged to have comparable attractiveness to business and increased economic development.

4. TRANSIENT ECONOMIC CONCERNS

   a. What will be the relative impact of project construction on local employment during the construction period based on this plan alternative?

      Ranks with Plan A to 1990, but due to less requirement for local type labor at 1990 than Plan D, ranks below Plan D. The high capital costs in 1990 are associated with equipment.

   b. What relative impact will the construction of this plan alternative have on local manufacturing and materials supply business?

      Potential for sale of local materials and products ranks lower than Plan D due to relatively small amounts of construction

required in conveyance facilities and the large amounts in imported special equipment.

c. What relative impact will the construction of this plan alternative have on temporary disruptions of circulation and/or business activity that will result in reduced employment or other economic loss?

Ranks with Plan A at 2nd from lowest in disruption potential.

5. SOCIAL CONCERNS FOR THE COMMUNITY

a. What relative impact will this plan alternative have on the health, welfare and safety of the community?

All candidate plans are formulated to have a strong positive impact on health, welfare and safety. The screening of potential negative impacts indicates that this plan has exposures associated with surface water and raw sewage pumping and has no exposures associated with groundwater and irrigation. This plan is ranked 2nd in lowest risk along with Plans A and B.

b. Will the implementation of this plan alternative cause disruptions of existing community living patterns such as location, quality and character of residential communities, locations and kinds of employment and general cultural activities?

This plan, along with Plans A, C and H will have negligible disruptive impact on the community.

c. What relative impact will this plan alternative have on the recreation patterns of the community?

Provides high absolute improvement of surface water above present conditions but ranks below plans which completely eliminate surface water disposal. Does not divert any land areas to disposal use. Relative rank is highest of any alternative that utilizes surface water due to the very high quality effluent but is ranked lower for concerns described in paragraph 9 below.

d. What relative impact will this plan alternative have on land use and land use planning?

All plans, except the no action plan, by solving area-wide wastewater management problems remove one of the constraints to development thereby making land use planning an essential for controlled development. This plan does not preempt any extensive lands and thus ranks lowest in physical constraints on land use along with Plans A, C and H.

6. SOCIAL CONCERNS FOR THE INDIVIDUAL

a. Will the implementation of this plan alternative cause dislocations which will effect the place of residence, employment, mobility and general cultural activity of a significant number of individuals?

This plan, along with Plans A, C and H, will cause negligible disruption of individuals.

b. To what extent will the implementation of this plan impact individual life style?

All plans have negligible impact on general life style.

7. CONCERN FOR GROUNDWATER QUALITY

a. What is the relative potential of this plan for impact on groundwater quality?

The surface water disposal at the City STP for the NS and C service areas has almost zero potential for groundwater impact since, on the average, the groundwater exchange is into the river downstream from the City STP except in the immediate vicinity of Nine Mile Dam. The surface water disposal for SV service area at approximate R.M. 79 is selected to be downstream from the main City wells at Parkwater but is upstream from a reach that, on the average, discharges from the river into groundwater. Primarily because of the effluent location at R.M. 79, this plan is ranked to have a higher potential impact on an important groundwater body than Plan C which has a discharge only at the City STP. Due to the greater importance of the Spokane Valley aquifer, the significance of this potential impact is ranked higher than those due to possible percolation from irrigation in Plans E, F and G. Plan J is ranked with Plans A and H but with some recognition of the higher quality effluent.

8. CONCERN FOR SURFACE WATER QUALITY

a. What is the relative potential of this plan for impact on surface water quality?

To 1990 the impact on surface water quality is equal to Plan A. The very high quality effluent after 1990 raises its level of protection almost to that of land application like Plan D. Due to the always remaining potential for a malfunction, Plan J is ranked below Plan D.

9. CONCERNS FOR LAND USE

This plan does not have any large scale impacts on land use. A site is required for the Spokane Valley treatment plant in the vicinity of Felts Field and the area will be slightly larger than for Plan A due to the need for the tertiary units. The more significant impact is relative to the City STP. The existing site is not large enough to accommodate the tertiary units and there is no contiguous topographically suited land for expansion. The expansion will have to take place at a non-contiguous site which may involve lands presently dedicated to park or other public use. Although the area required is small compared with land application, its specific location requirements could create a public acceptance problem.

a. What relative impact will this plan have on the quantity or quality of land available for wildlife habitat, natural vegetation and open space?

   Potential loss at site required for City STP expansion is a moderate negative impact.

b. What relative impact will this plan have on the aesthetic quality of the landscape?

   Again, the specific locational needs of the site for City STP expansion could have a moderate impact on a scenic part of the river.

c. What constraints will this plan place on other beneficial uses of land?

   Does not introduce any large scale constraints. The two sites at Felts Field and at the City STP are the only constraints.

10. CONCERNS FOR AIR QUALITY

a. What effect will the implementation of this plan alternative have on the public health aspects of air quality?

   No negative impact. Ranks with Plans A, C, D and H which also have no negative impact on health aspects of air quality.

b. What effect will the implementation of this plan alternative have on the aesthetic aspects of air quality?

   There is a moderate potential for negative impact from treatment plants. Two treatment sites, both with solids handling and with carbon regeneration increase the odor potential over one site plan.

11. CONCERNS FOR ENERGY AND RESOURCES

a. How does this project compare with other plan alternatives with respect to the need for:

1) Electrical Energy Input?

To 1990 the energy rate is same as Plan A and lowest of all alternatives. After 1990 the greatly increased requirements for advanced treatment elements, particularly nitrification and ozone disinfection, bring energy requirements higher than all plans except E and F. Requirement is 674.8×10^6 kwh.

2) Thermal energy input?

Negligible for all plans.

b. How does this plan alternative compare with other alternatives with respect to need for consumption of chemicals or other consumable resources which may be in short supply?

Ranks with Plans A, C and H which have identical alum usages required for phosphorus removal to surface waters for all three service areas, but in addition requires significant quantities of methanol for denitrification after 1990.

c. What positive aspects does this plan alternative have with respect to salvage of energy or reusable chemical resources?

The entire flow of all three service areas is discharged to the Spokane River and become available for power production in WWP dams and downriver Columbia installations. There is no recovery of nutrient chemicals. The direct hydro energy recovery potential of this plan and Plans A, B, C and H is approximately equal to the energy equivalent of recovered nitrogen fertilizer of Plan F at 125 to 135×10^6 kwh.

d. How does this plan compare with other plan alternatives in net energy requirements after considering credits for resource recovery potential?

Net energy requirement at 540×10^6 kwh ranks this Plan between Plans D and G; higher than D but lower than G.

12. PERFORMANCE EVALUATION

a. How does this plan alternative compare with others in technical performance toward releasing to the environment the highest

quality renovated wastewater?

To 1990 this plan ranks with Plan A in having two secondary treated effluent discharges to surface water. After 1990 the quality released is raised to a very high level so that the impact is limited to TDS and possibly some exotic compounds that might pass carbon adsorption. Net rank with Plan D.

b. How does this plan alternative compare with others in reliability of technical performance?

Lack of storage between treatment and ultimate discharge to the environment causes this plan to be ranked lower in reliability than all land application types.

13. FLEXIBILITY

a. How does this plan alternative rate for its flexibility in being adaptable to unanticipated changes in rate and location of growth?

The complex treatment facility after 1990 makes expansion of capacity more difficult than Plan A but not as difficult as major transmission expansion required for land application.

b. How does this plan alternative rate for its flexibility in adapting to possible changes in water quality criteria and goals?

The very high level of treatment provided in the proposed upgrade make this plan capable of meeting any reasonable increase in disposal criteria or goals. Ranked highest with Plan F.

c. How does this plan alternative rate for flexibility in being able to utilize future changes in technology of wastewater treatment?

Since this plan is locked into a very large cost investment for site intensive treatment it is not as flexible as less elaborate systems. If breakthroughs take place before the proposed implementation date of 1990, this system is in a better position than plans which are fully committed from the start. Ranked between Plans D and F.